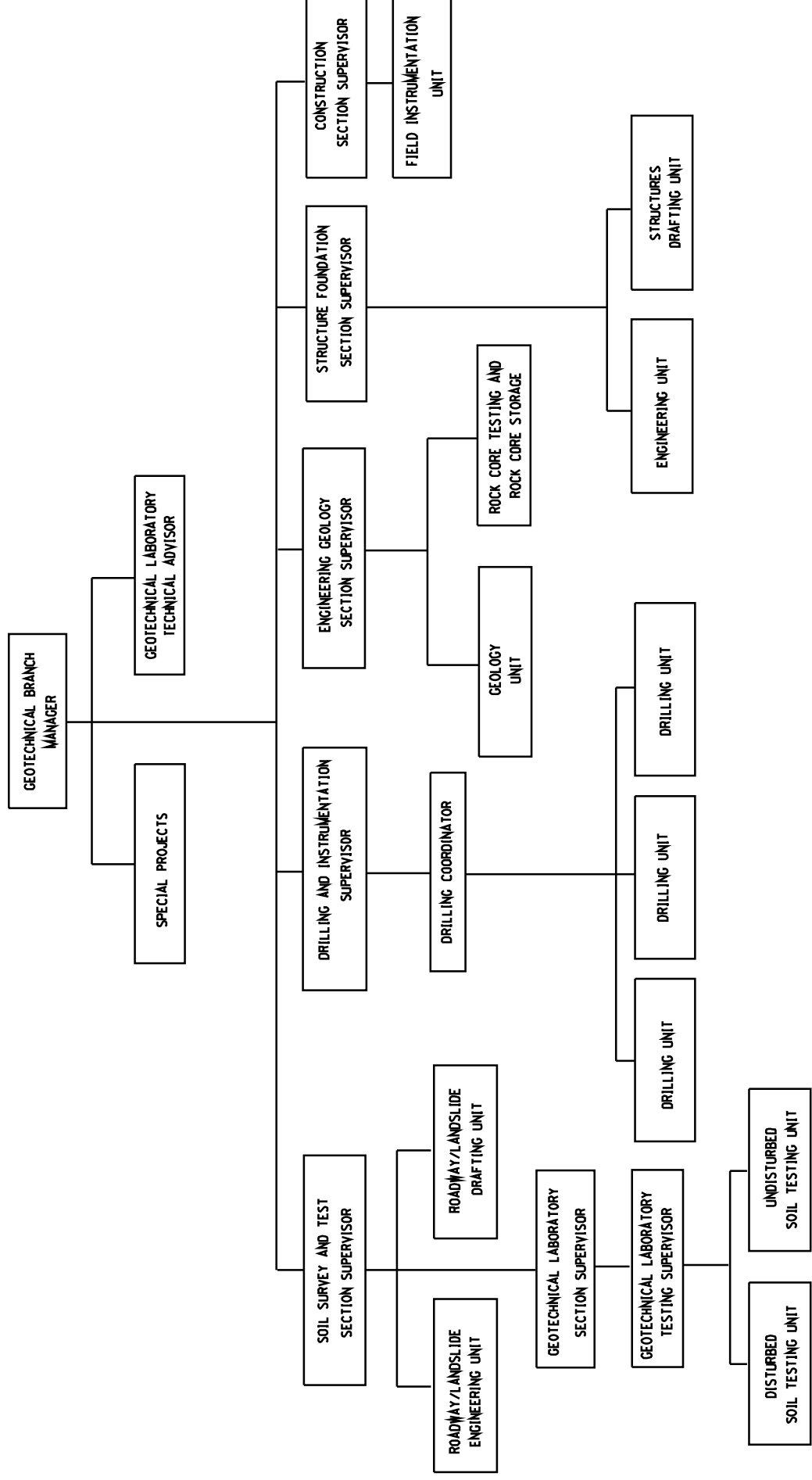


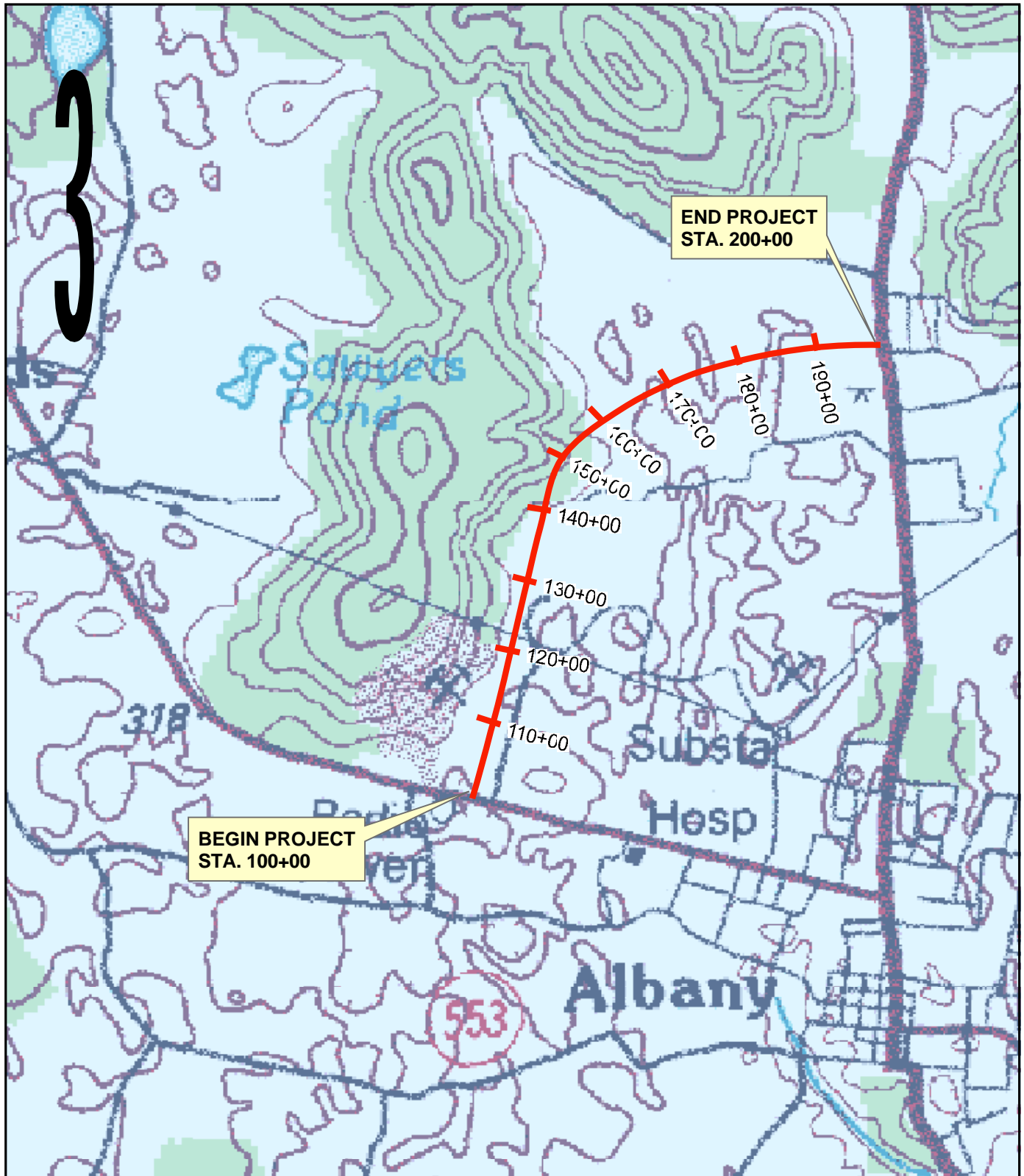
Kentucky Transportation Cabinet - Division of Materials Organizational Chart For Geotechnical Branch

1236 Wilkinson Boulevard; Frankfort KY 40601-1200
PH (502) 564-2374 FAX (502) 564-4839



SPRINGFIELD CO ALBANY NW BYPASS

Exhibit 2



1" = 2000'

SPRINGFIELD COUNTY
US 555 ALBANY NW BYPASS
FD52 126 0555 005-023 009 D
MARS # 68594 01D
ITEM # 13-765.00

01/01/05

Exhibit 3

KENTUCKY TRANSPORTATION CABINET

Division of Materials

Geotechnical Branch

TC 64-515

SUBSURFACE LOG

Page 1 of

[illegible]

Division of Materials
Geotechnical Branch

TC 64-515

Page ____ of ____

Hole No. _____

[illegible]

TC 64-515

Geotechnical Branch

Page 3 of 0Hole No. 0[illegible]

TC 64-515

Geotechnical Branch

Page 4 of 0

Hole No. 0

[illegible]

KENTUCKY TRANSPORTATION CABINET

Division of Materials

Geotechnical Branch

TC 64-515

SUBSURFACE LOG

Page 1 of 1

County <u>Springfield</u>		Item No. <u>13-765.00</u>		Location <u>Station 63+50, 25 Feet Left</u>	
Project No. <u>FD52 126 0555 005-023 009 D</u>				Latitude _____ Longitude _____	
Mars No. <u>6859401D</u>		Surface Elevation <u>956.3</u> Ft.		Hole Number <u>1A</u> Total Depth <u>35.0</u> Ft.	
Road Number <u>New Albany NW Bypass (US 555)</u>				Date Started <u>02/02/75</u> Date Completed <u>02/02/75</u>	
Project Type <u>Roadway</u>				Depth to Water (Immediate) _____	
Driller's Name <u>B. Jones</u>		Geologist _____		Depth to Water (7 Day) <u>N/A</u> Date _____	

Lithology		Overburden	Sample No.	Depth	Rec. (Ft.)	SPT Blows	Sample Type	Remarks
Elevation	Depth	Description	RQD	Run	Rec. (Ft.)	Rec. (%)	SDI (JS)	
	3.0	Brown, clayey-silt, sandy lenses, dry						
	7.5	Gray, silty-clay, moist, w/ sandstone boulders (Auger Refusal)	#1	5.0-6.5	1.5	5-7-4	SPT	
	11.6	Weathered brown sandstone		2.5	2.1	84		10.0
	21.1	Brown and gray sandstone w/ shale layers (Lost water @ 15.0')		5.0	4.7	94		15.0
	32.0	Gray sandy shale		10.0	9.8	98		25.0
	35.0	Gray sandstone		10.0	9.9	99		
		(End of Core 35.0')						

KENTUCKY TRANSPORTATION CABINET

Division of Materials

Geotechnical Branch

TC 64-515

Springfield South Quadrangle
GQ #4567
Dakota Formation

SUBSURFACE LOG

Page 1 of 1

County <u>Springfield</u> Item No. <u>13-765.00</u>		Location <u>Station 415+06.52, 22.5 Feet Right</u>	
Project No. <u>FD52 126 0555 005-023 009 D</u>		Latitude <u>85° 55' 28"</u> Longitude <u>38° 28' 46"</u>	
Mars No. <u>6859401D</u> Surface Elevation <u>469.5</u> Ft.		Hole Number <u>#13</u> Total Depth <u>36.0</u> Ft.	
Road Number <u>New Albany NW Bypass (US 555)</u>		Date Started <u>04/01/04</u> Date Completed <u>04/01/04</u>	
Project Type <u>Bridge Over Buckhill River</u>		Depth to Water (Immediate) <u>11.0</u> Ft.	
Driller's Name <u>B. Jones</u> Geologist <u>A. Smith</u>		Depth to Water (7 Day) <u>N/A</u> Date <u></u>	

Lithology		Overburden	Sample No.	Depth	Rec. (Ft.)	SPT Blows	Sample Type	Remarks
Elevation	Depth	Description	RQD	Run	Rec. (Ft.)	Rec. (%)	SDI (JS)	
		Overburden	#1	2.0-4.0	1.4		ST	
			#2	5.0-7.0	1.7		ST	
			#3	10-11.5		21-22-10	SPT	
456.5	13.0							
450.3	19.2	Limestone: light gray, coarse crystalline, w/ many shale laminations and limited partings	42	3.0	2.8	93		16.0
		Limestone: light gray, fine to coarse crystalline, argillaceous with wavy to nodular bedding, fossiliferous	20	10.0	9.7	97		26.0
433.5	36.0		31	10.0	10.0	100		
		Top of Rock = 13.0 Elevation 456.5						
		Base of Weathered Rock = 13.5 Elevation 456.0						
		The Allowable Bearing Capacity is 10 tons/square foot at Elevation 456.0						

KENTUCKY TRANSPORTATION CABINET

Division of Materials
Geotechnical Branch

TC 64-515

Springfield South Quadrangle
GQ #5689 Nevada
Formation, Elm member

SUBSURFACE LOG

Page 1 of 1

County <u>Springfield</u> Item No. <u>13-765.00</u>		Location <u>Station 32+00, 80 Feet Right</u>	
Project No. <u>FD52 126 0555 005-023 009 D</u>		Latitude <u>82° 34' 22"</u> Longitude <u>37° 48' 12"</u>	
Mars No. <u>6859401D</u> Surface Elevation <u>964.2</u> Ft.		Hole Number <u>2C</u> Total Depth <u>42.0</u> Ft.	
Road Number <u>New Albany NW Bypass (US 555)</u>		Date Started <u>11/26/02</u> Date Completed <u>11/27/02</u>	
Project Type <u>Roadway</u>		Depth to Water (Immediate) <u>N/A</u>	
Driller's Name <u>B. Jones</u> Geologist <u>A. Smith</u>		Depth to Water (7 Day) <u>N/A</u> Date <u></u>	

Lithology		Overburden	Sample No.	Depth	Rec. (Ft.)	SPT Blows	Sample Type	Remarks
Elevation	Depth	Description	RQD	Run	Rec. (Ft.)	Rec. (%)	SDI (JS)	
		Overburden w/ sandstone boulders						
960.4	3.8							
		Shale: brown to dark gray, clayey to silty, carbonaceous zones, occasional sandstone partings, slickensided throughout, highly fractured and weathered above 7.4'	0	5.0	4.5	90		8.8
951.0	13.2							
		Sandstone: gray, fine grain, numerous shale laminations, cross bedded, non-durable	12	10.0	9.8	98		
947.2	17.0							75° Joint @ 18.3-20.2
		Shale (siltstone): gray, sandy, with iron nodules, rooted, coal spars						18.8
942.9	21.3							
		Coal Seam w/ 0.5' shale parting (Recovered 2.3 Ft.)	34	10.0	9.2	92		
940.1	24.1							
		Shale (claystone): gray, plastic, slickensided						Shale zone @ 28.7-29.8
938.1	26.1							28.8
		Sandstone: light gray, medium to coarse grain, few shale laminations, shale clasts in zones, crossbedding, intermittent water stains, durable	71	10.0	10.0	100		
								Conglomerate @ 36.5-37.1
								38.8
			82	3.8	3.8	100		
922.2	42.0							80° Water Stained Joint @ 40.3-42.0
		RDZ = 7.4 Ft.						

KENTUCKY TRANSPORTATION CABINET

Division of Materials
Geotechnical Branch

TC 64-516

SUMMARY OF ROCKLINE SOUNDINGS

Page 1 of [illegible]

Exhibit 8

KENTUCKY TRANSPORTATION CABINET

Division of Materials

Geotechnical Branch

TC 64-516

SUMMARY OF ROCKLINE SOUNDINGS

Page 1 of 1

[illegible]

Exhibit 9

KENTUCKY TRANSPORTATION CABINET

Division of Materials

Geotechnical Branch

TC 64-515

SUBSURFACE LOG

Page 1 of 1

County <u>Springfield</u> Item No. <u>13-765.00</u>			Location <u>Station 61+00, 25 Feet Left</u>						
Project No. <u>FD52 126 0555 005-023 009 D</u>			Latitude _____		Longitude _____				
Mars No. <u>6859401D</u> Surface Elevation _____ Ft.			Hole Number <u>#16</u>		Total Depth <u>17.0</u> Ft.				
Road Number <u>New Albany NW Bypass (US 555)</u>			Date Started <u>11/10/04</u>		Date Completed <u>11/10/04</u>				
Project Type <u>Profile</u>			Depth to Water (Immediate) <u>N/A</u>						
Driller's Name <u>B. Jones</u> Geologist _____			Depth to Water (7 Day) <u>N/A</u> Date _____						
Lithology		Description	Overburden	Sample No.	Depth	Rec. (Ft.)	SPT Blows	Sample Type	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. (Ft.)	Rec. (%)	SDI (JS)	
	11.0	Brown, silty clay, moist, firm *Bag #4						NMC #6 @ 4' NMC #7 @ 9'	
	17.0	Gray, silty, wet, soft **Soil Type #3						NMC #8 @ 14'	
(No Refusal)									
Note: Pond Located at station 61+20, 20 feet left. Pond is approximately 30 feet wide and runs to station 61+40. Note: Possible landslide between stations 61+50 - 64+00.									
* Indicates bag was obtained in this boring. ** References soil type from a bag sample obtained from a previous boring.									

KENTUCKY TRANSPORTATION CABINET **SPECIFICATIONS FOR CORE BOX**

COUNTY _____
PROJECT NO. _____
CORE LOCATION _____
SURFACE ELEV. _____
BOX ____ OF ____

COUNTY		DATE
PROJECT NO.		
CORE LOCATION	BOX	OF

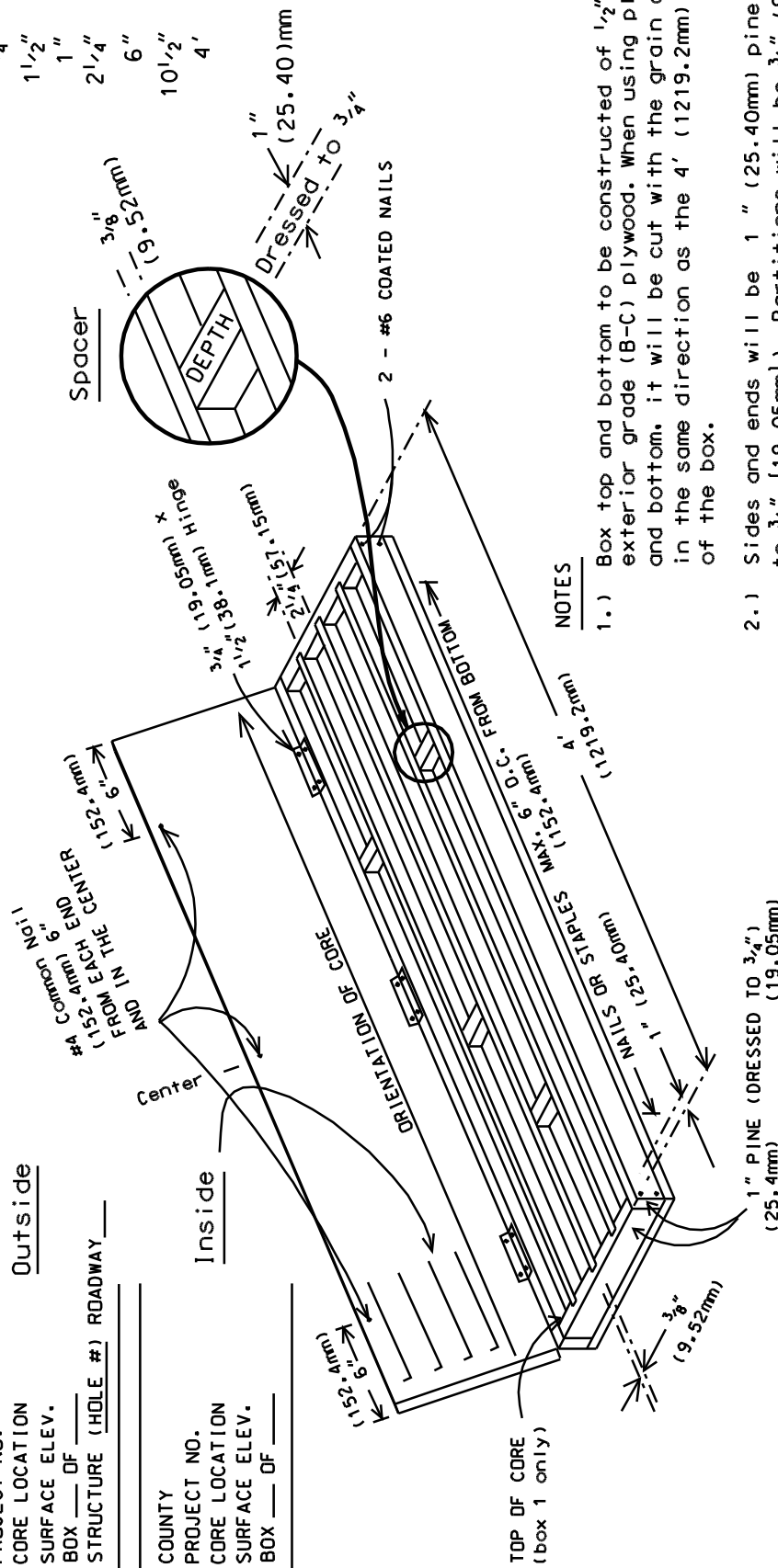
2 - # 6 COATED
NAILS IN SIDES

End View

3 - # 6 COATED
NAILS IN BOTTOM

10 1/2" (254 mm)

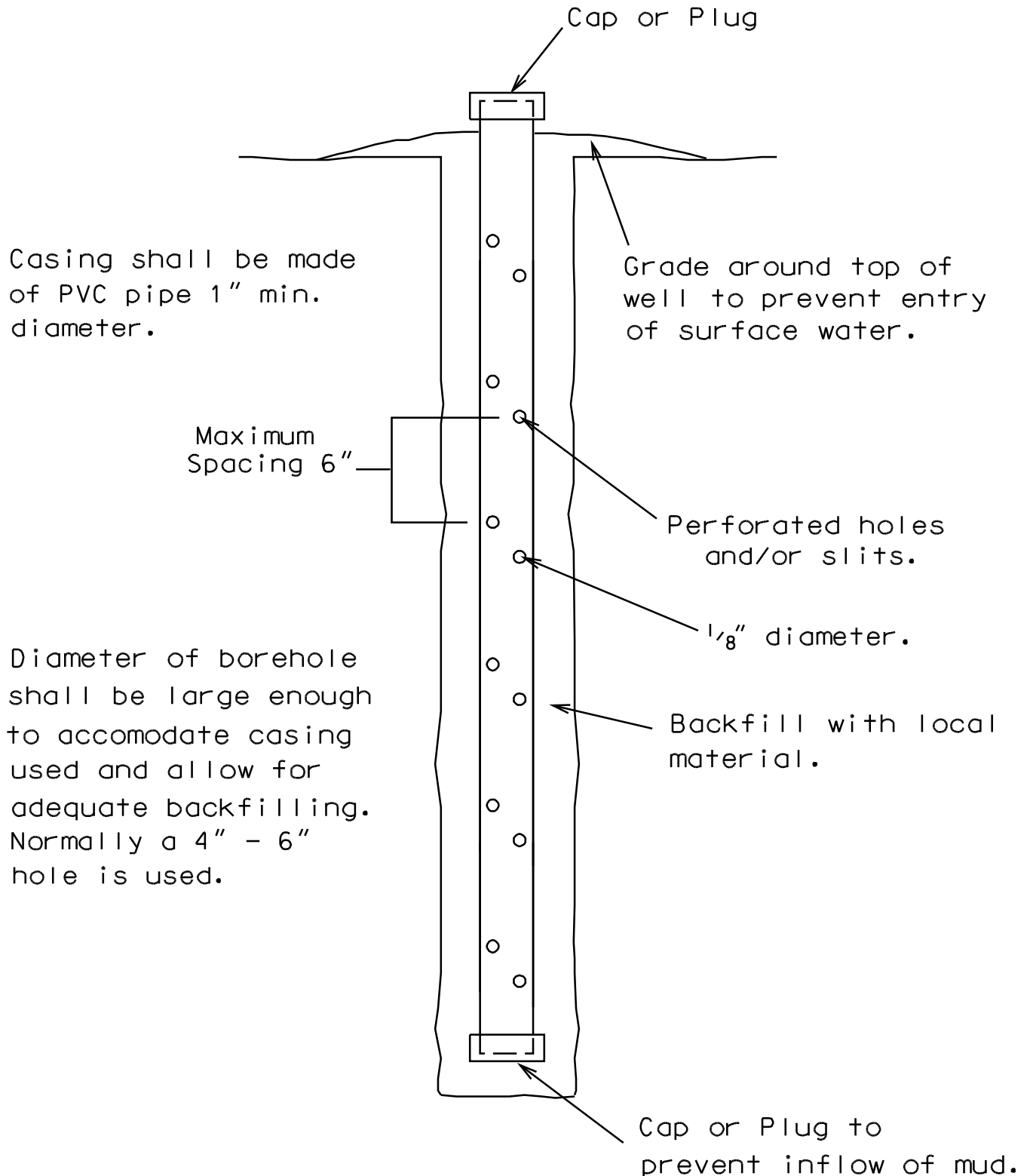
Exhibit10.dgn 7/26/2005 10:43:44 AM



NOTES

- 1.) Box top and bottom to be constructed of $\frac{1}{2}$ " (12.70mm) exterior grade (B-C) plywood. When using plywood for top and bottom, it will be cut with the grain of plywood in the same direction as the 4' (1219.2mm) length of the box.
- 2.) Sides and ends will be 1" (25.40mm) pine; (dressed to $\frac{3}{4}$ " [19.05mm]). Partitions will be $\frac{3}{8}$ " (9.52mm) pine.
- 3.) #6 cc (penny) coated sinker nails or coated staples are required to assemble parts of the box.
- 4.) Top lid will have 3 hinges secured with 4 - # 6 screws $\frac{1}{2}$ " (12.70mm) into lid and $\frac{3}{4}$ " (19.05mm) into sides.
- 5.) All partitions and spacers to be removable.
- 6.) Letter box as shown. Letters to be bold and indelible.
- 7.) Enclose copy of Geologist and Driller's log inside Box No. 1.
- 8.) Closure of lid shall be secured with 3 - # 4 common nails.

CASED OBSERVATION WELL



THIN-WALLED TUBE & SPT SAMPLE LOG

Assigned By: B. King

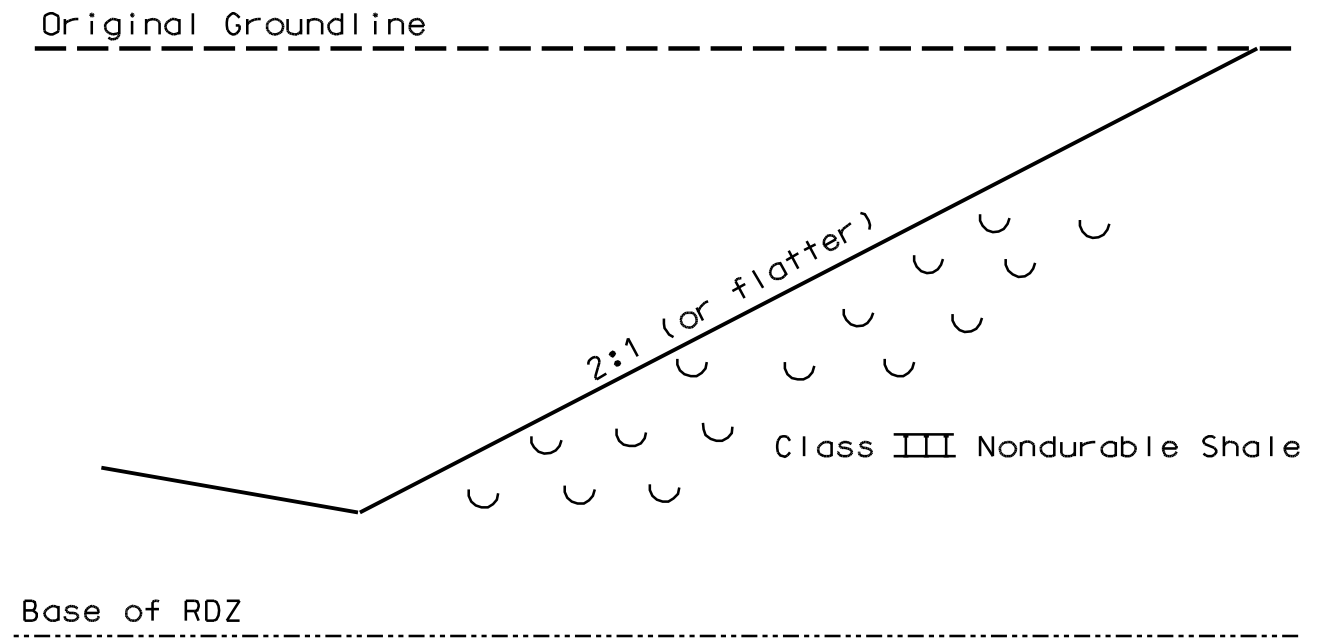
Date: 2/30/04 Mars # 6895401D Item # 13-765.00 Logged By: R. McDonald Date 2/30/04

County Springfield Project # FD52 126 0555 005-023 009 D Page 1 of 1

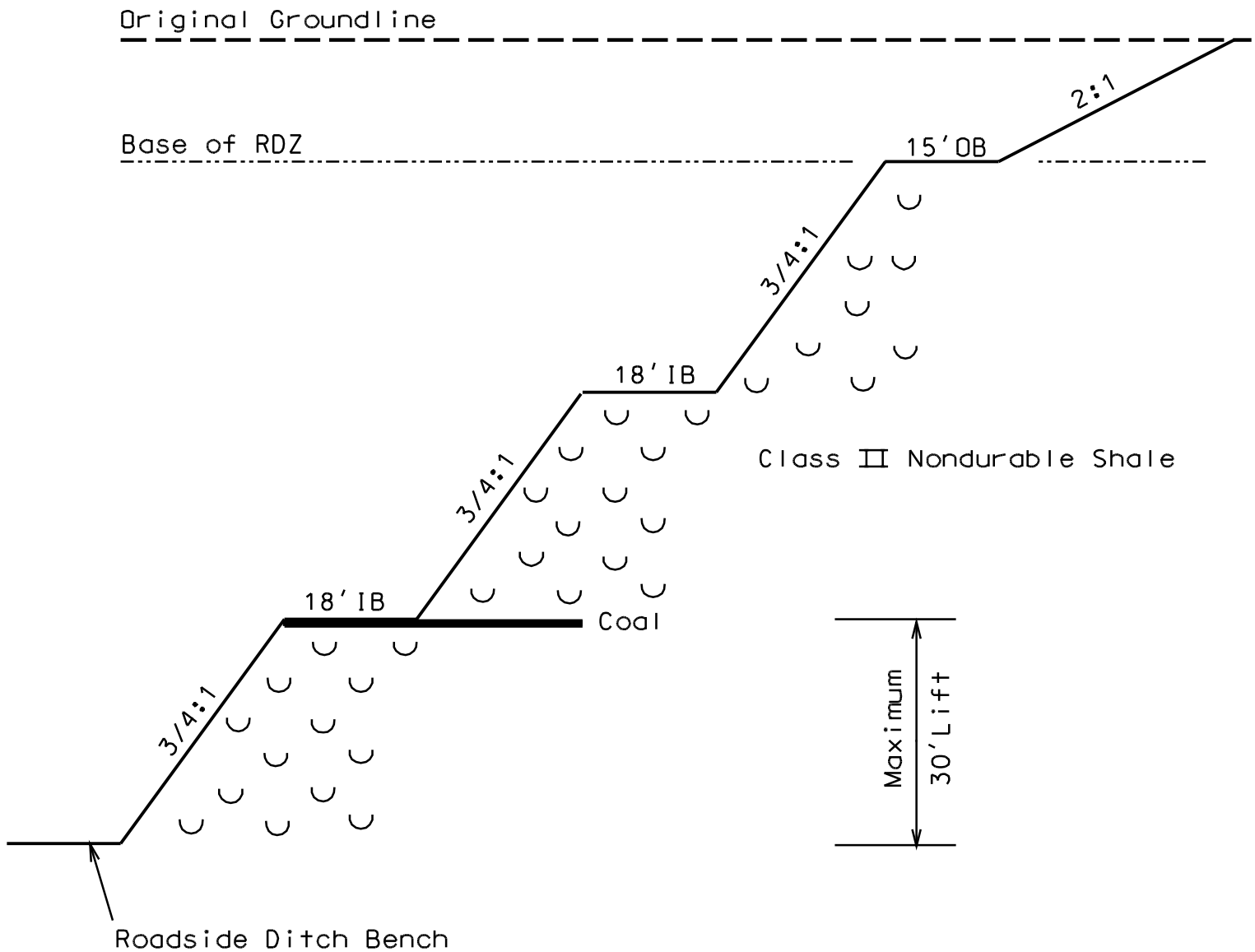
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Typical Slope Configuration

Class III Nondurable Shale

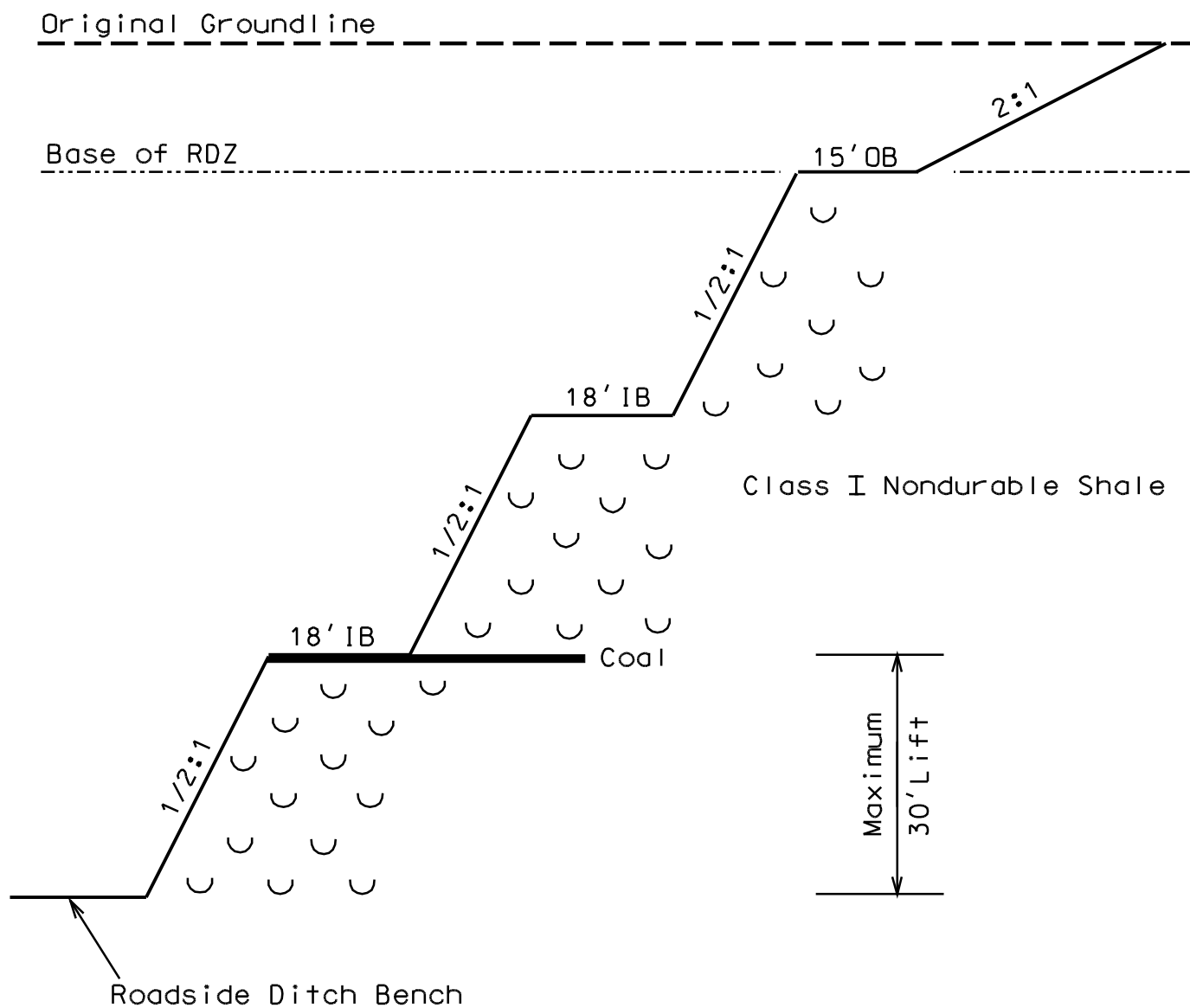


Typical Slope Configuration Class II Nondurable Shale



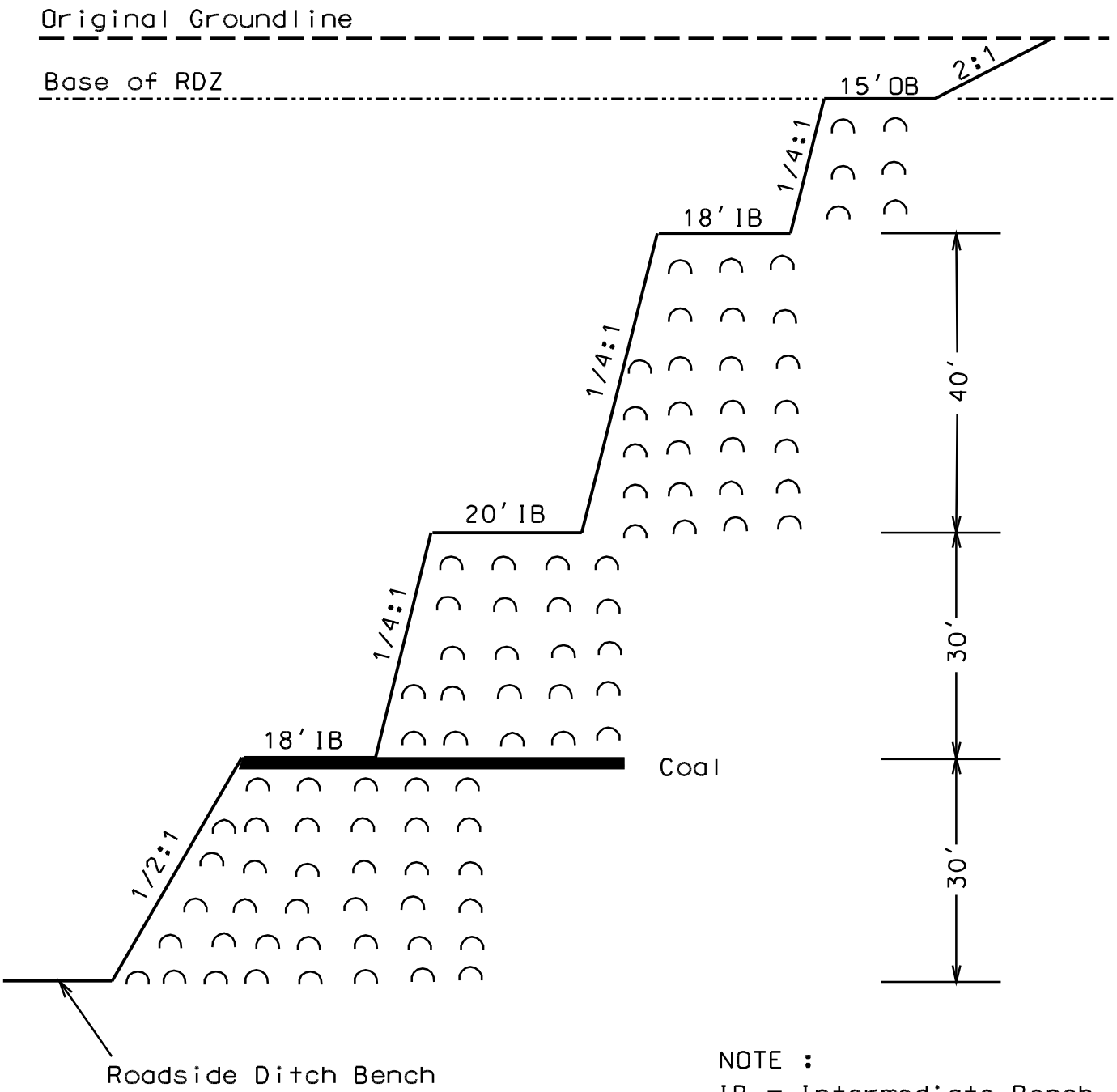
NOTE :
IB = Intermediate Bench
OB = Overburden Bench

Typical Slope Configuration Class I Nondurable Shale



NOTE :
IB = Intermediate Bench
OB = Overburden Bench

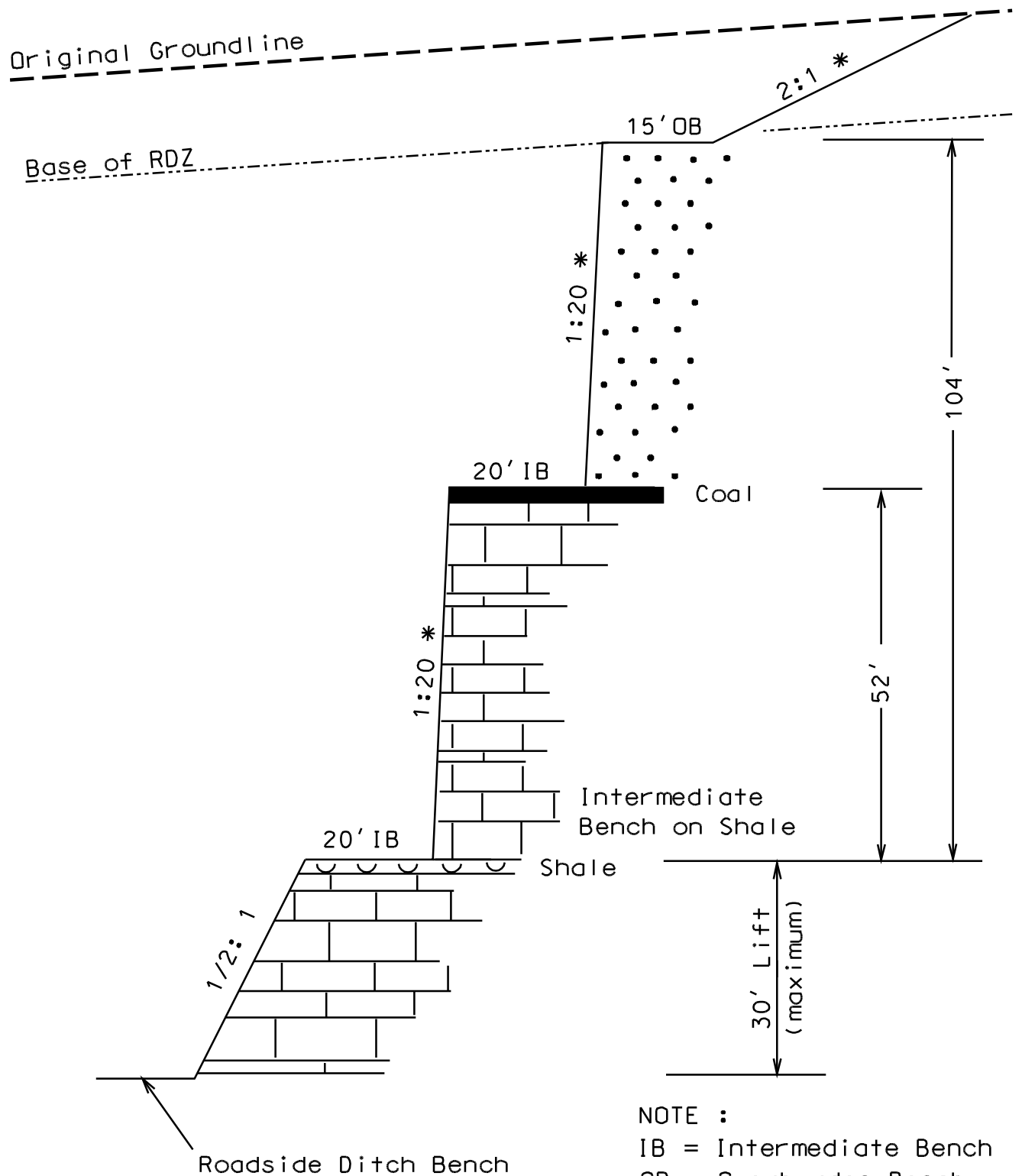
Typical Slope Configuration Durable Shale



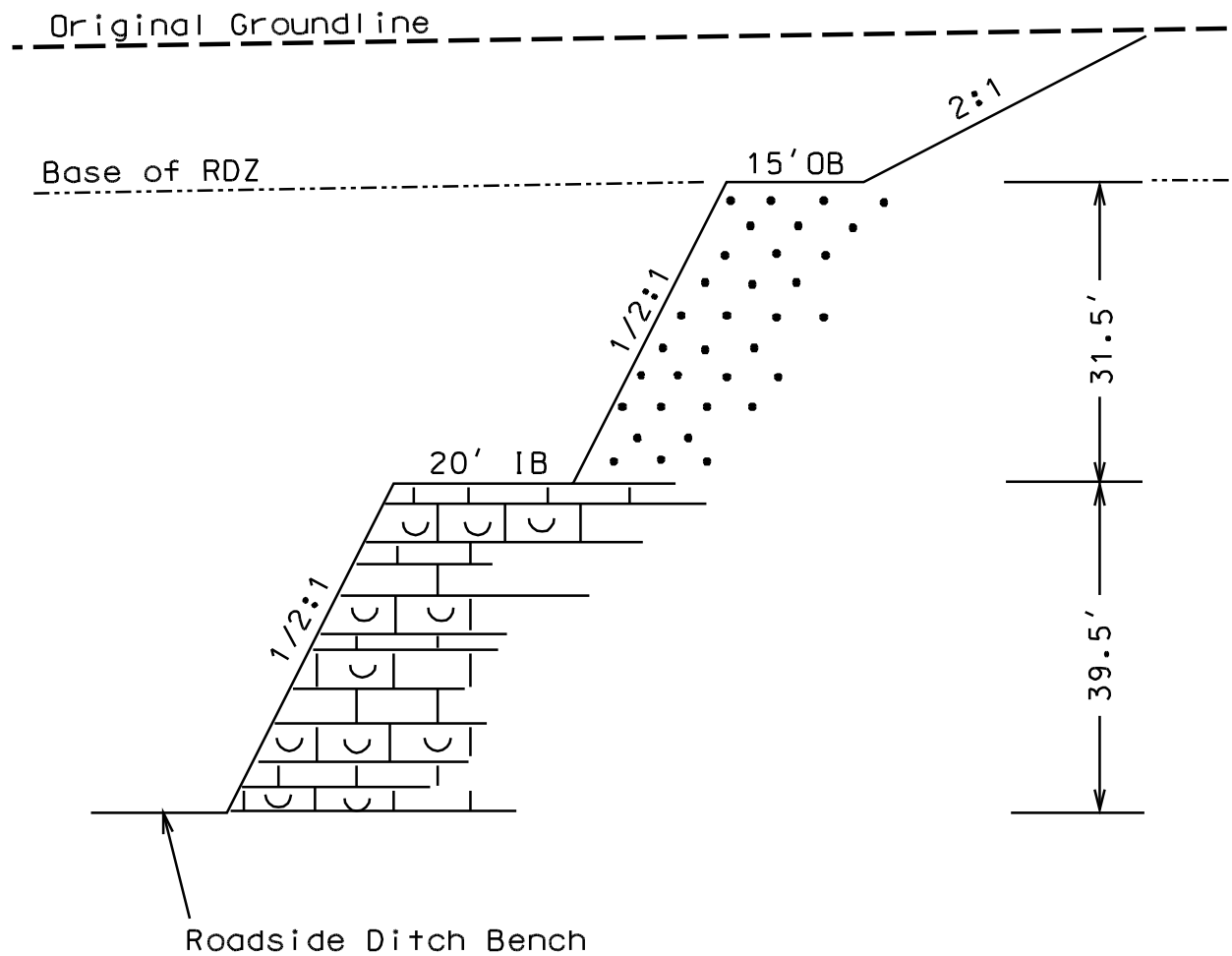
NOTE :
IB = Intermediate Bench
OB = Overburden Bench

Typical Slope Configuration Massive Limestone or Sandstone

* Slopes are shown at maximum steepness



Typical Slope Configuration Shaley Limestone or Sandstone



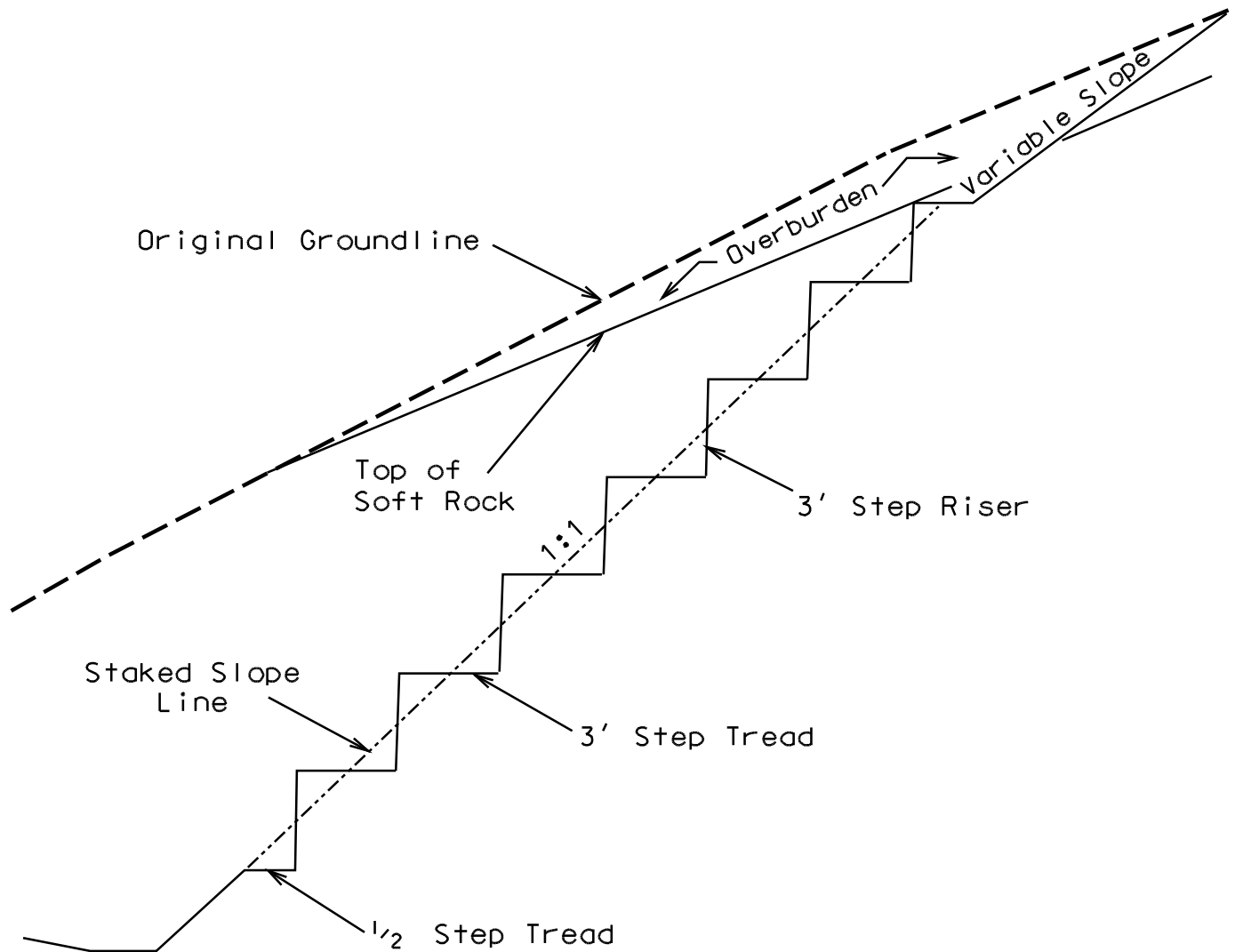
NOTE :

IB = Intermediate Bench

OB = Overburden Bench

Typical Slope Configuration

1:1 Serrated Slopes



NOTE :

1:1 slope configuration shown.

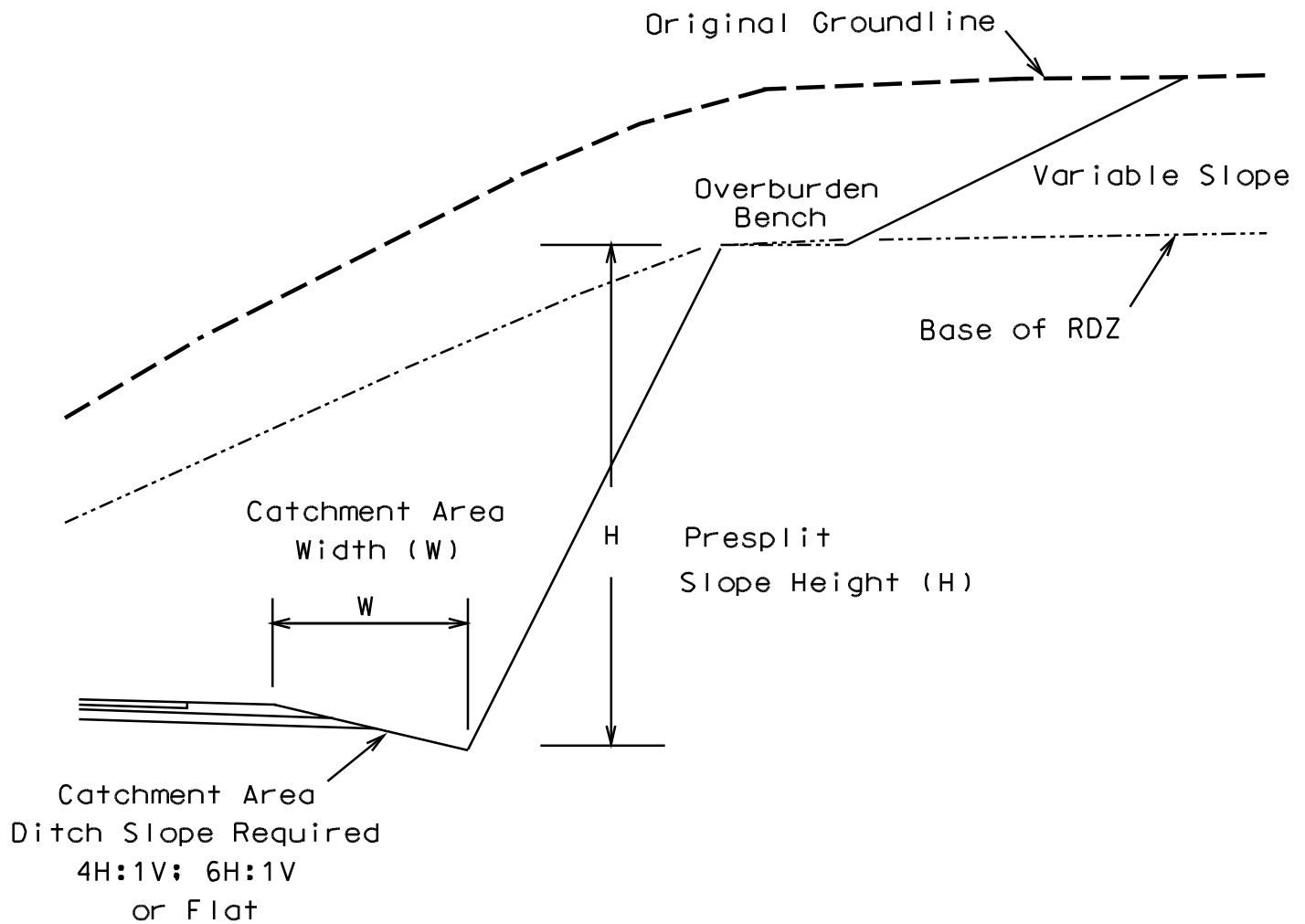
For a 1 1/2:1 slope (not shown)

use 2' riser with a 3' tread

or 4' riser with a 6' tread.

Roadside Ditch Catchment Area

For a Copy of Guidelines Contact the
Kentucky Department of Highways
Division of Materials
Geotechnical Branch



KENTUCKY TRANSPORTATION CABINET
Division of Materials
Geotechnical Branch

TC 64-532

County

Item No.

Project No.

Geotechnical Branch

SUMMARY OF ROCK QUANTITIES

Submittal No.

Date

Page

_____ of _____

SUMMARY OF ROCK QUANTITIES

[illegible]

Division of Materials
Geotechnical Branch

Page 1 of 1

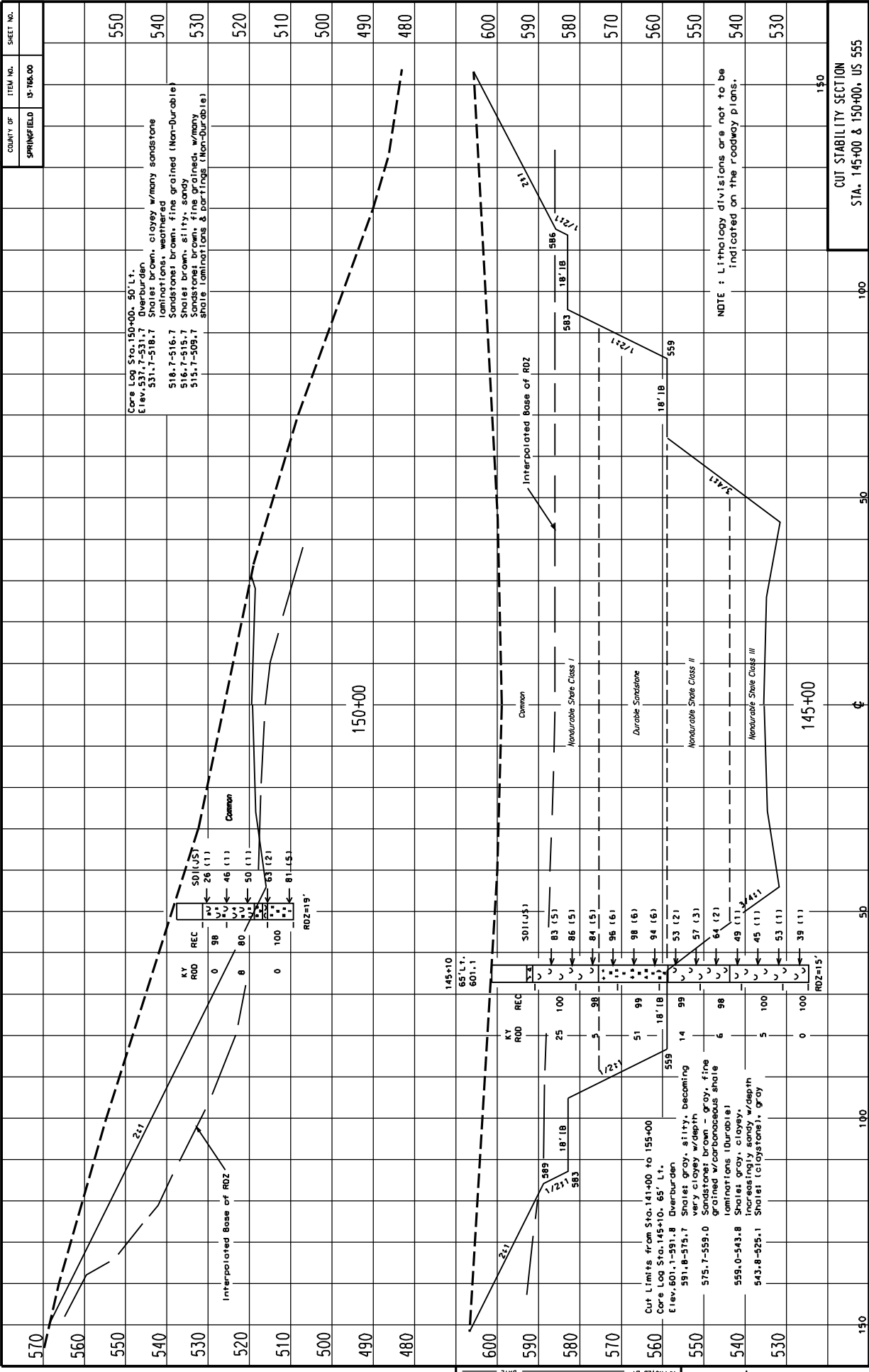
Submittal No. 1

SUMMARY OF ROCK QUANTITIES

Project No. FD52 126 0555 005-023 009 D

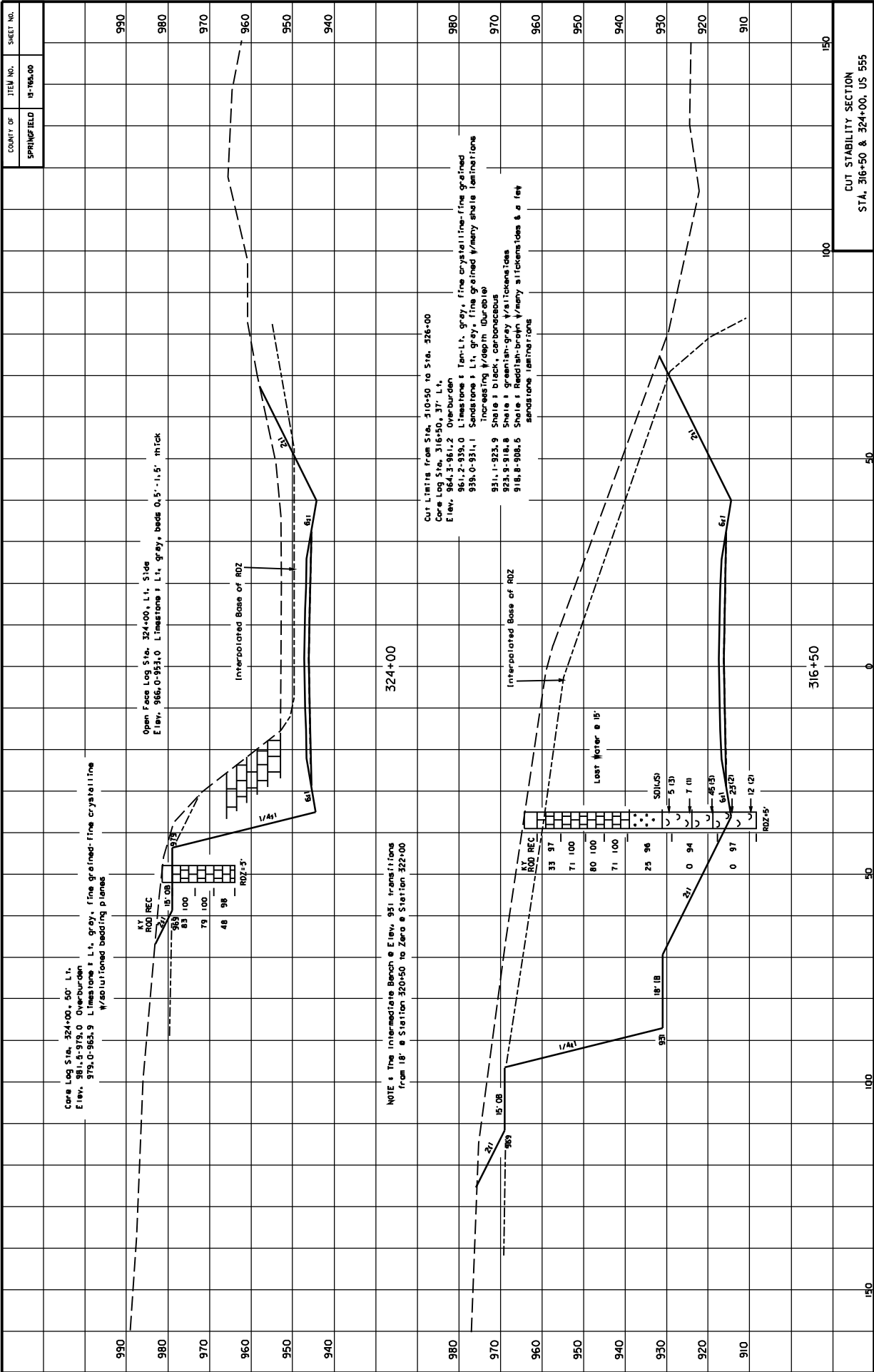
Date 5/6/2003

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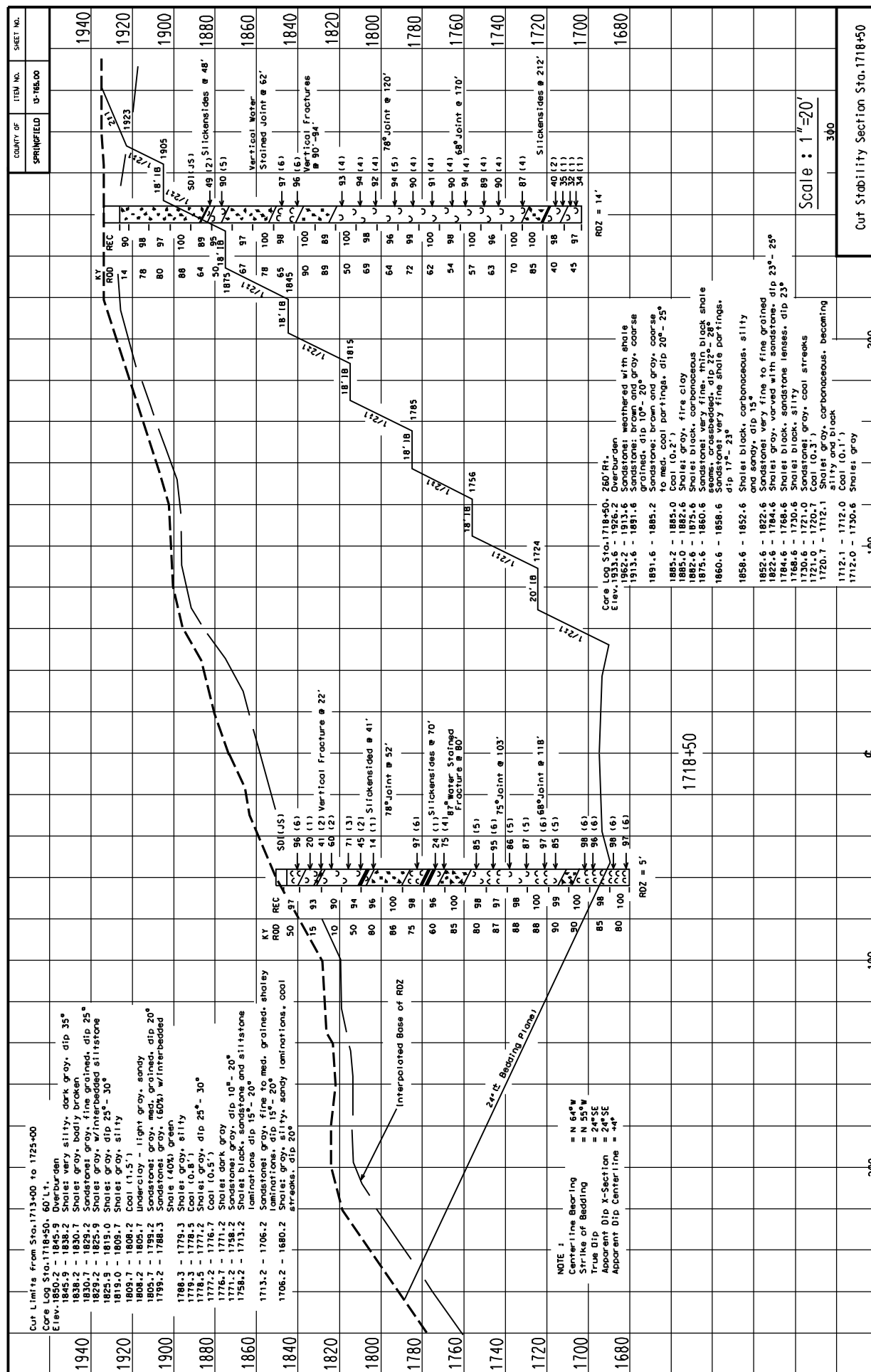
PREPARED BY _____ DATE _____
CHECKED BY _____ DATE _____
APPROVED BY _____ DATE _____

Cell: LBR/RY/KYT/CLM
DO: MM/YY/YY HH:MM



Cell Library KY 1500
DO NOT REUSE
10-11-2011

PREPARED BY	DATE
CHECKED BY	DATE
APPROVED BY	DATE



_____ DATE	_____ APPROVED BY
_____ DATE	_____ CHECKED BY
_____ DATE	_____ PREPARED BY

00-44447-00
Call Number 530
Call Number 530

CU TRIAXIAL TEST

Page 1 of 3

Project Data:

County: Springfield

Route: US 555

Date: 08/02/04

Operator: B. King

Project #: FD52 129 0555 005-023 009 D

Item #: 13-765.00

Failure Criterion: Maximum Obliquity

Values at Failure:

Circle Number	Time (min)	PWP (psi)	Cell Pressure (psi)	Δ L (in)	Piston Force (P) (lbs)	ε -Vertical Strain	Deviator Stress (psi)	σ ₁ (psi)	σ ₃ (psi)
1	150	68.37	75	0.3904	133.6348	0.069777	19.54	94.54	75
2	207	62.99	75	0.5342	207.9203	0.095838	29.68	104.68	75
3	210	56.8	75	0.5443	286.1745	0.098143	41.2	116.2	75

Calculated Values:

PQ:

•'(deg)	a(psi)
25.7	1.9

% Difference PQ vs. Mohr:

•'(deg)	c'(psf)
28.8	305.7

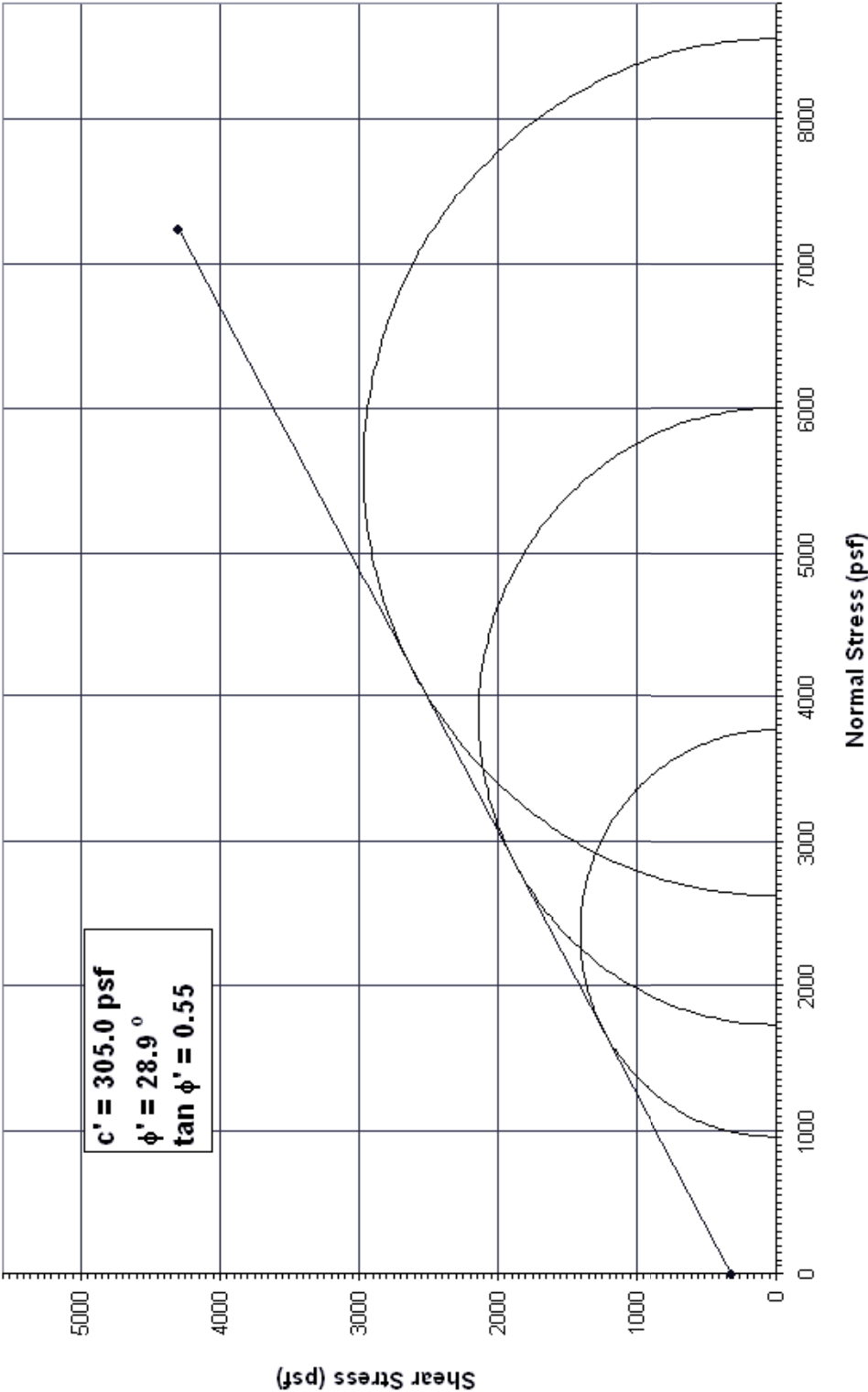
•'(deg)	c'(psf)
28.9	305.0

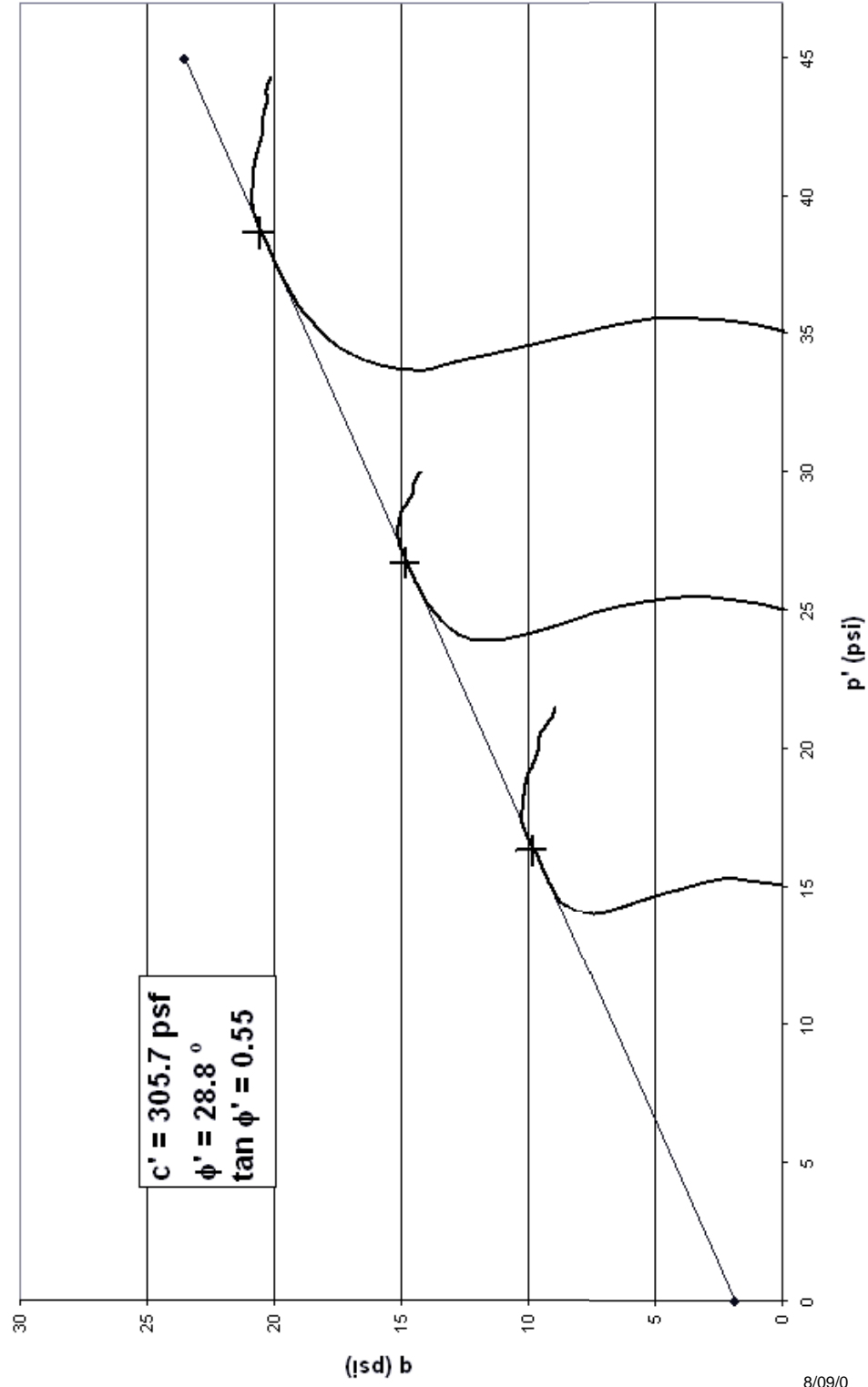
Test Results Based on Mohr Circle Analysis:

Comments:

Specimen Data:

Circle #	Station	Depth	Description	KMIM #	Initial Pressures: Cell	Back	Moisture Content
1	40+50, 20 LT.	15-17.5'	Gray Clay	0019	75	60	20.5%
2	40+50, CL	15-17.5'	Gray Clay	0022	75	50	17.3%
3	40+50, CL	20-22.5'	Gray Clay	0023	75	40	19.2%





KENTUCKY TRANSPORTATION CABINET

Division of Materials
Geotechnical Branch
1236 Wilkinson Blvd.
Frankfort, KY 40601

Tested by: Chris GrovesTechnical Responsibility: Dean Clements

Consolidated, Undrained Triaxial Compression Test
AASHTO T 297-94

Date: 7/26/2004
Operator: B. King
File Name: Spring_15
Item #: 13-765.00
Project #: FD52 129 0555 005-023 009 D
Mars #: 6895401D
Load Frame #: 1
Cell #: 1

County: Springfield
Station: 40+50
Offset: 20' LT.
Hole #: 35
Depth: 15-17.5'
Visual Description: Gray Clay
Panel #: 1

Penetrometer/Torvane Readings:

1.) 0.5
2.) 0.7
3.) 0.4
Average: 0.5

Moisture Content:

	Initial	Final
Can #:	105	28
Tare (g):	46.3	55.12
Wet Sample + Tare (g):	336.2	113.96
Dry Sample + Tare (g):	286.9	102.63
Moisture Content:	20.5	23.8

Sample Diameter (# . # # # in.):

1.) 2.723
2.) 2.891
3.) 2.798
Average: 2.804

Initial Weight (g):

1238.4

Sample Height (# . # # # in.):

1.) 5.862
2.) 5.731
3.) 5.815
Average: 5.803

Saturation Pressure:

Cell (psi): 62
Back (psi): 60

B-Value Determination:

Pressure, u , before increasing σ_3 (psi): 59.5
Pressure, u , after increasing σ_3 (psi): 69.3
B-Value ($\Delta u / \Delta \sigma_3$): 98 %

Consolidation Pressure:

Cell (psi): 75
Back (psi): 60

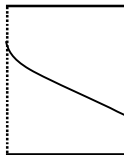
Shear:

20%
0.0025 in./min.

Piston Measurement (in.):

5.176 (before saturation)

Failure Sketch:



Remarks:

Consolidation Data:

Time (Min.)	Alternate Units	Burette Reading	Piston Reading
0	0 (sec)	49.3	5.190
0.1	6 (sec)	48.5	
0.2	12 (sec)	47.2	
0.5	30 (sec)	46.9	
1	1 (min)	46.5	
2	2 (min)	46.0	
4	4 (min)	45.3	
8	8 (min)	44.2	
15	15 (min)	42.8	5.126
30	30 (min)	41.1	5.109
60	1 (hr)	38.7	5.085
120	2 (hr)	36.1	5.060
240	4 (hr)	33.5	5.034
480	8 (hr)	31.2	5.011
1440	24 (hr)	29.6	4.995

Start Date: 7/27/04Start Time: 8:00 AM

KENTUCKY TRANSPORTATION CABINET

Division of Materials
Geotechnical Branch
1236 Wilkinson Blvd.
Frankfort, KY 40601

Tested by: Chris GrovesTechnical Responsibility: Dean Clements

Consolidated, Undrained Triaxial Compression Test
AASHTO T 297-94

Date: 7/26/2004
Operator: B. King
File Name: Spring_15
Item #: 13-765.00
Project #: FD52 129 0555 005-023 009 D
Mars #: 6895401D
Load Frame #: 1
Cell #: 2

County: Springfield
Station: 40+50
Offset: CL
Hole #: 36
Depth: 15-17.5'
Visual Description: Gray Clay
Panel #: 1

Penetrometer/Torvane Readings:

1.) 0.8
2.) 0.3
3.) 0.4
Average: 0.5

Moisture Content:

	Initial	Final
Can #:	<u>3</u>	<u>60</u>
Tare (g):	<u>48</u>	<u>54.52</u>
Wet Sample + Tare (g):	<u>339</u>	<u>116.01</u>
Dry Sample + Tare (g):	<u>296</u>	<u>102.27</u>
Moisture Content:	<u>17.3</u>	<u>28.8</u>

Sample Diameter (# . # # # in.):

1.) 2.753
2.) 2.855
3.) 2.796
Average: 2.801

Initial Weight (g):

1210.5

Sample Height (# . # # # in.):

1.) 5.891
2.) 5.828
3.) 5.811
Average: 5.843

Saturation Pressure:

Cell (psi): 62
Back (psi): 60

B-Value Determination:

Pressure, u , before increasing σ_3 (psi): 59.4
Pressure, u , after increasing σ_3 (psi): 69.3
B-Value ($\Delta u / \Delta \sigma_3$): 99 %

Consolidation Pressure:

Cell (psi): 75
Back (psi): 50

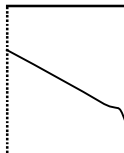
Shear:

20%
0.0025 in./min.

Piston Measurement (in.):

5.178 (before saturation)

Failure Sketch:



Remarks:

Consolidation Data:

Time (Min.)	Alternate Units	Burette Reading	Piston Reading
0	0 (sec)	49.2	5.193
0.1	6 (sec)	47.7	
0.2	12 (sec)	47.4	
0.5	30 (sec)	47.0	
1	1 (min)	46.5	
2	2 (min)	46.0	
4	4 (min)	45.2	
8	8 (min)	44.3	
15	15 (min)	43.0	5.132
30	30 (min)	41.4	5.116
60	1 (hr)	39.4	5.096
120	2 (hr)	37.4	5.076
240	4 (hr)	36.0	5.062
480	8 (hr)	35.7	5.059
1440	24 (hr)	35.4	5.056

Start Date: 7/28/04Start Time: 8:00 AM

KENTUCKY TRANSPORTATION CABINET

Division of Materials
Geotechnical Branch
1236 Wilkinson Blvd.
Frankfort, KY 40601

Tested by: B. King

Technical Responsibility: R. McDonald
Consolidated, Undrained Triaxial Compression Test
AASHTO T 297-94

Date:	7/26/2004	County:	Springfield
Operator:	C. Doe	Station:	40+50
File Name:	Spring_15	Offset:	CL
Item #:	13-765.00	Hole #:	36
Project #:	FD52 129 0555 005-023 009 D	Depth:	20-22.5'
Mars #:	6895401D	Visual Description:	Gray Clay
Load Frame #:	1	Panel #:	1
Cell #:	3		

Penetrometer/Torvane Readings:

1.)	0.6
2.)	0.5
3.)	0.4
Average:	0.5

Moisture Content:

	Initial	Final
Can #:	25	63
Tare (g):	46.4	55.42
Wet Sample + Tare (g):	283.2	159.68
Dry Sample + Tare (g):	245	141.76
Moisture Content:	19.2	20.8

Sample Diameter (# . # # # in.):

1.)	2.823
2.)	2.894
3.)	2.806
Average:	2.841

Initial Weight (g):

1227.3

Sample Height (# . # # # in.):

1.)	5.862
2.)	5.799
3.)	5.828
Average:	5.830

Saturation Pressure:

Cell (psi):	62
Back (psi):	60

B-Value Determination:

Pressure, u , before increasing σ_3 (psi):	60.2
Pressure, u , after increasing σ_3 (psi):	70.2
B-Value ($\Delta u / \Delta \sigma_3$):	100 %

Consolidation Pressure:

Cell (psi):	75
Back (psi):	40

Shear:

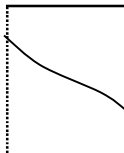
20%
0.0025 in./min.

Piston Measurement (in.):

5.147

(before saturation)

Failure Sketch:

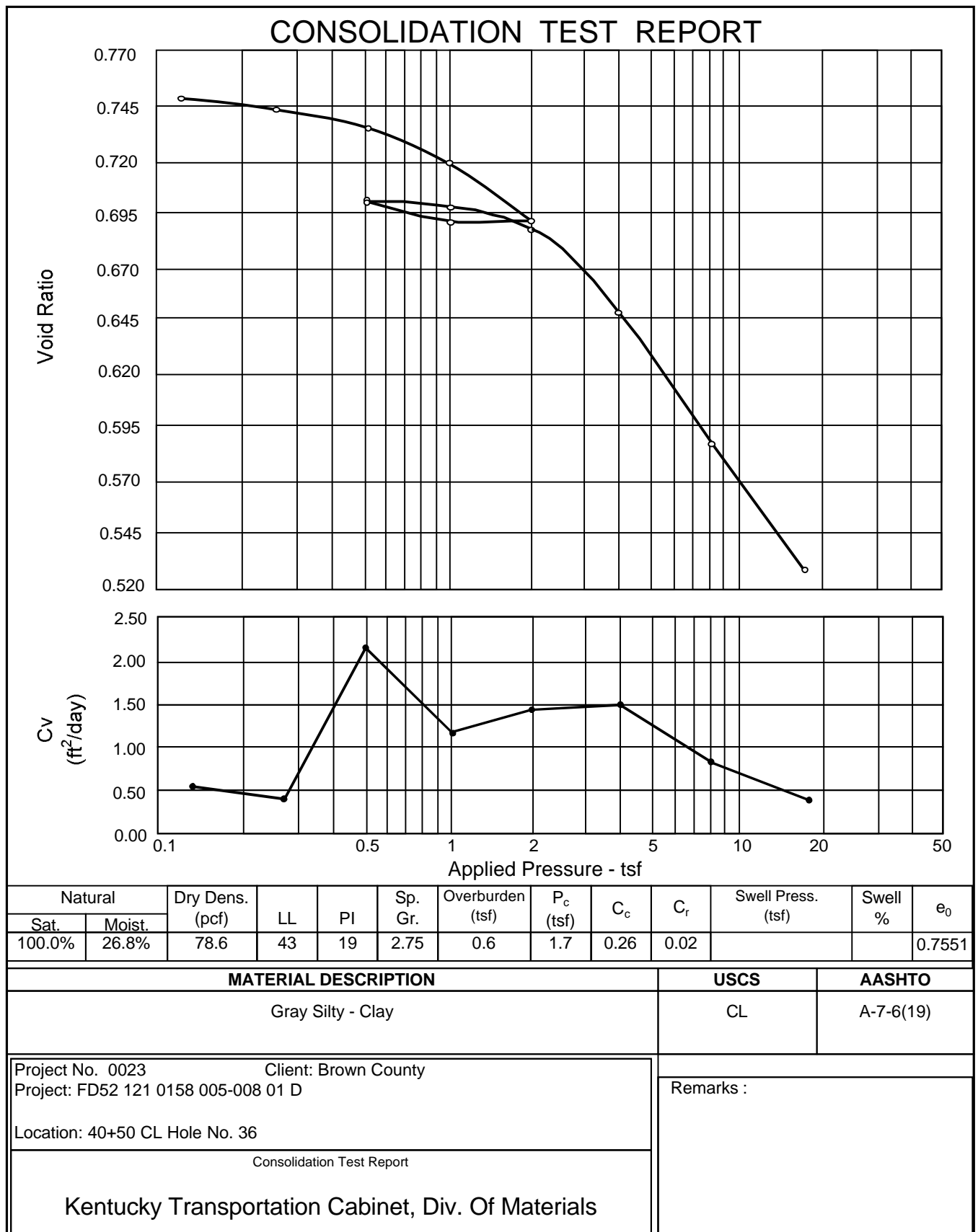


Remarks:

Consolidation Data:

Time (Min.)	Alternate Units	Burette Reading	Piston Reading
0	0 (sec)	49.3	5.161
0.1	6 (sec)	43.0	
0.2	12 (sec)	42.1	
0.5	30 (sec)	40.2	
1	1 (min)	38.5	
2	2 (min)	36.6	
4	4 (min)	34.8	
8	8 (min)	33.3	
15	15 (min)	32.5	4.999
30	30 (min)	32.1	4.995
60	1 (hr)	31.9	4.993
120	2 (hr)	31.7	4.992
240	4 (hr)	31.5	4.990
480	8 (hr)	31.4	4.989
1440	24 (hr)	31.4	4.989

Start Date: 7/29/04Start Time: 8:00 AM



GEOTECHNICAL SYMBOL SHEET

AASHTO Classification of Soils and Soil-Aggregate Mixtures

General Classification	Granular Materials (5% or less passing 0.075 mm)										Silt-Clay Materials (More than 5% passing 0.075 mm)			
	A-1		A-3		A-2		A-4		A-5		A-6		A-7	
	A-1-a	A-1-b	A-3	A-3	A-2-4	A-2-5	A-2-6	A-2-7	A-4	A-5	A-6	A-6	A-7-5	A-7-6
Group Classification	50 max	---	---	---	---	---	---	---	---	---	---	---	---	---
	2.00 mm (No. 10)	---	---	---	---	---	---	---	---	---	---	---	---	---
	0.425 mm (No. 40)	---	---	---	---	---	---	---	---	---	---	---	---	---
Sieve Analysis Percent Passing	15 max	25 max	10 max	---	35 max	35 max	35 max	35 max	35 min	35 min	35 min	35 min	35 min	35 min
	0.075 mm (No. 200)	---	---	---	---	---	---	---	---	---	---	---	---	---
	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Characteristics of Fraction Passing 0.425 mm (No. 40)	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Liquid Limit Plasticity Index	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	---	---	---	---	---	---	---	---	---	---	---	---	---	---

PI	Plasticity Index
AJ	Activity Index
LI	Liquidity Index
S+C	Silt + Clay (% finer than No.200 Sieve)
○	Rockline Soundings
●	Disturbed Sample Boring
◎	Undisturbed Sample Boring
⊙	Undisturbed Sample Boring & Rock Core
●	Rock Core
⊖	Slope inclinometer Installation
⊖	typical applications:
⊖	Observation Well
⊖	Water Elevation
⊖	Field Vane Shear Strength
⊖	Thin-Walled Tube Sample
⊖	Standard Penetration Test Sample
⊖	Penetration Resistance
⊖	Unconfined Compressive Strength
⊖	Unconsolidated Undrained Triaxial Strength
⊖	Moisture Content
⊖	Rock Quality Designation (Kentucky Method)
⊖	Rock Quality Designation (Standard Method)
⊖	Slake Durability Index (Jar Slake Test)
⊖	Core Recovery
⊖	Angle of Internal Friction (Total Stress)
⊖	Angle of Internal Friction (Effective Stress)
⊖	Cohesion (Total Stress)
⊖	Cohesion (Effective Stress)
⊖	Total Unit Weight
⊖	Rock Disintegration Zone
⊖	Overburden Bench
⊖	Intermediate Bench
⊖	Refusal
⊖	Refusal Not Encountered

LIMESTONE
SANDSTONE
DURABLE SHALE (SDI ≥ 95)
NONDURABLE SHALE (SDI < 95)
COAL
TALUS, MINE WASTE, FILL MATERIAL, BOULDERS, & ETC.
GRANULAR EMBANKMENT
STRUCTURE GRANULAR BACKFILL
SLOPE PROTECTION

Unified Soil Classifications

MAJOR DIVISIONS	SYMBOL	NAME
GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
	GP	Poorly graded gravels or gravel-sand mixtures, little or no fines.
	GM	Silty gravels, gravel-sand-silt mixtures.
	GC	Clayey gravels, gravel-sand-clay mixtures.
	SW	Well-graded sands or gravelly sands, little or no fines.
	SP	Poorly graded sands or gravelly sands, little or no fines.
	SM	Silty sands, sand-silt mixtures.
	SC	Clayey sands, sand-clay mixtures.
	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
	CL	Inorganic clays of low to medium plasticity, lean clays.
FINE GRAINED SOILS	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
	CH	Inorganic clays of high plasticity, fat clays.
	NONE	Non-classified material (i.e. overburden, pavement, etc.) Include visual description.
UNCLASSIFIED MATERIAL		

COUNTY OF	ITEM NO.	SHEET NO.
SPRINGFIELD	9-765.00	

GEOTECHNICAL NOTES

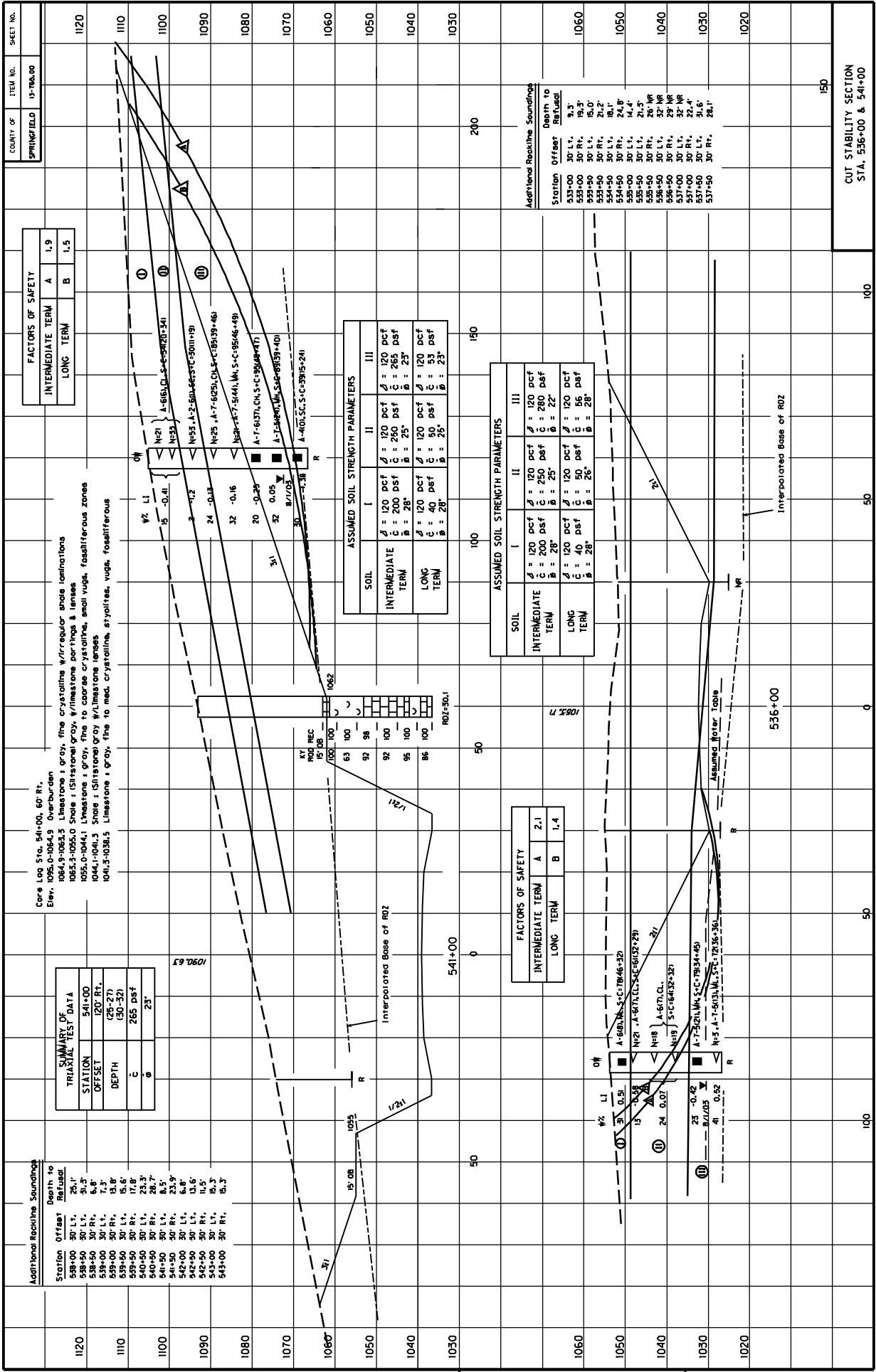
11. In accordance with Section 206 of the current Standard Specifications, the moisture content of embankment material shall not vary from the optimum moisture content as determined by K₆ 64-511 by more than +2 percent or less than -2 percent. This moisture content requirement shall have equal weight with the density requirement when determining the acceptability of embankment construction. Refer to the Family of Curves for moisture/density correlation.
12. All soils, whether from roadway or borrow, may require manipulation to obtain proper moisture content prior to compaction. Direct payment shall not be permitted for rehandling, hauling, stockpiling, and/or manipulating soils.
13. Excavation of surface ditches and channel changes adjacent to embankment areas shall be performed prior to the placement of the adjacent embankments. The material excavated for the channel changes and surface ditches is suitable for embankment construction if dried to proper moisture content in accordance with Section 206 of the current Standard Specifications.
14. The contractor is responsible for conducting any operations necessary to excavate the cut areas to the required typical section. These operations shall be incidental to the roadway price.
15. Perforated pipe for subgrade drainage shall be placed in vertical sags in accordance with R0P-005 at the following approximate locations and/or where designated by the Engineer.
- MAINLINE**
- | | | |
|----------------|----------------|----------------|
| Station 219+75 | Station 292+00 | Station 374+00 |
| Bushong Rd. | Connection A | KY 678 West |
| Station 32+50 | Station 50+50 | Station 47+00 |
16. The contractor shall construct foundation embankment benches and transverse benches as indicated on the plans and/or as directed by the Engineer, prior to placement of embankments in areas requiring such benches.
17. Transverse benching and/or perforated pipe underdrains shall be installed at the following approximate locations and any others designated by the Engineer. Contrary to Standard Drawing R0P-006, transverse benches and perforated pipe underdrains shall be placed on both the upgrade and downgrade cut to fill transitions.
- MAINLINE**
- | | | | |
|----------------|----------------|----------------|----------------|
| Station 224+90 | Station 238+10 | Station 247+50 | Station 263+00 |
| Station 268+40 | Station 278+00 | Station 282+80 | Station 289+30 |
| Station 303+90 | Station 307+75 | Station 316+80 | Station 330+90 |
| Station 342+60 | Station 346+40 | Station 352+00 | Station 361+50 |
| Station 368+75 | Station 370+30 | Station 373+60 | Station 387+50 |
| Station 393+75 | Station 412+50 | Station 422+25 | Station 433+80 |
| Station 443+70 | | | |
- Backbridge School Rd.**
- | | |
|---------------|---------------|
| Station 49+50 | KY 678 East |
| | Station 36+25 |
18. Foundation embankment benches shall be placed in accordance with Standard Drawing R0X-010 at the locations listed below and/or as directed by the Engineer.
- MAINLINE**
- | | |
|-------------------------------|-------------------------------|
| Stations 242+75 to 243+25 Rt. | Stations 243+75 to 246+75 Lt. |
| Stations 264+75 to 266+75 Rt. | Stations 316+25 to 317+25 Lt. |
| Stations 330+75 to 334+75 Lt. | Stations 348+75 to 354+75 Rt. |
| Stations 373+25 to 374+25 Lt. | Stations 409+25 to 412+75 Rt. |
| Stations 426+25 to 431+75 Rt. | Stations 432+75 to 433+75 Lt. |
| Stations 443+75 to 444+25 Rt. | |
19. The contractor shall conduct grading operations in such a manner that limestone and/or durable shale (SD) \geq 95% from roadway excavation be stockpiled separately or otherwise manipulated so that ample quantities are available for those areas requiring sold material. No direct payment will be allowed for such necessary manipulating as stockpiling, hauling and/or handling the material.

10. The contractor shall conduct grading operations in such a manner that soil from roadway excavation be stockpiled separately or otherwise manipulated so that ample quantities are available for a chemically stabilized roadbed meeting the specifications in Section 208 of the current Standard Specifications for Road and Bridge Construction. No direct payment will be allowed for such necessary manipulating as stockpiling, hauling and/or handling the material.
11. Any saturated, unstable material encountered in existing creek beds and/or drainage swales within embankment foundation limits shall be drilled and stabilized with 3"-11" of limestone and/or durable shale from roadway excavation or as directed by the Engineer. Positive drainage shall be maintained to prevent trapping water within the roadway embankment. The placement of this material is incidental to the unit bid price for roadway excavation or embankment-in-place.
12. Some of the soil horizons and slopes on the project are subject to erosion. Necessary procedures in accordance with Sections 212 and 213 of the current Standard Specifications shall be followed on construction.
13. The following cut intervals shall be constructed with 2 1/2' or flatter slopes.
- MAINLINE**
- | | |
|-------------------------------------|--------------------------------------|
| Stations 247+50 to 263+00 | Stations 268+50 to 276+50 |
| Stations 304+00 to 308+00 Left Side | Stations 342+50 to 346+50 Right Side |
| Stations 361+50 to 368+50 | Stations 370+50 to 373+50 |
| Stations 412+50 to 422+00 | Stations 434+00 to 443+50 |
- KY 678 West**
- | | |
|-------------------------|----------------|
| Stations 46+50 to 50+00 | John Eaton Rd. |
| Stations 44+50 to 56+50 | |
14. The following cut intervals shall be constructed with 3:1 or flatter slopes. Stability Sheets are attached.
- MAINLINE**
- | | |
|---------------------------|---------------------------|
| Stations 225+00 to 238+50 | Stations 316+50 to 331+50 |
|---------------------------|---------------------------|
15. Appropriate treatment, as outlined in the Standard Specifications, shall apply to all cisterns, septic tanks, and associated lateral lines within the construction limits.
16. A possible spring and/or pump house was noted during the field investigation at the following approximate locations. A spring box with a pipe outlet at the toe of slope shall be constructed if the Engineer determines that a defined area of flow can be located. If not, a 12" x 12" foot thick drainage blanket wrapped in Geotextile fabric, Type IV shall be placed approximately 12 feet wide to the toe of the embankment to assure positive drainage. The fabric shall be in accordance with Section 214 & 843, Type IV of the current edition of Standard Specifications for Road and Bridge Construction. The drainage blanket material shall consist of "Coarse Aggregate for Rock Drainage Blanket" in accordance with the current edition of Section 805 of the Standard Specifications for Road and Bridge Construction, except natural sand will not be permitted.
- MAINLINE**
- | | | |
|------------------------|---------------------------|---------------------------|
| Station 264+50 25' Rt. | Station 346+65 Centerline | Station 425+75 Centerline |
|------------------------|---------------------------|---------------------------|
17. The ponds at the following approximate locations are within roadway cut limits and shall be drained. Any soft, saturated material excavated from this cut area may not be suitable for use in embankments. Use of this material shall be limited to final dressing of roadway slopes, as directed by the Engineer.
- MAINLINE**
- | | |
|-------------------------|------------------------|
| Station 235+50 100' Rt. | Station 252+30 40' Lt. |
|-------------------------|------------------------|

KENTUCKY DEPARTMENT OF HIGHWAYS COUNTY OF SPRINGFIELD	PROJECT
	Subproject
GEOTECHNICAL NOTES	

PREPARED BY	DATE
CHECKED BY	DATE
APPROVED BY	DATE

Cell: 609.711.1111
Fax: 609.711.1111
Email: info@hwy.com



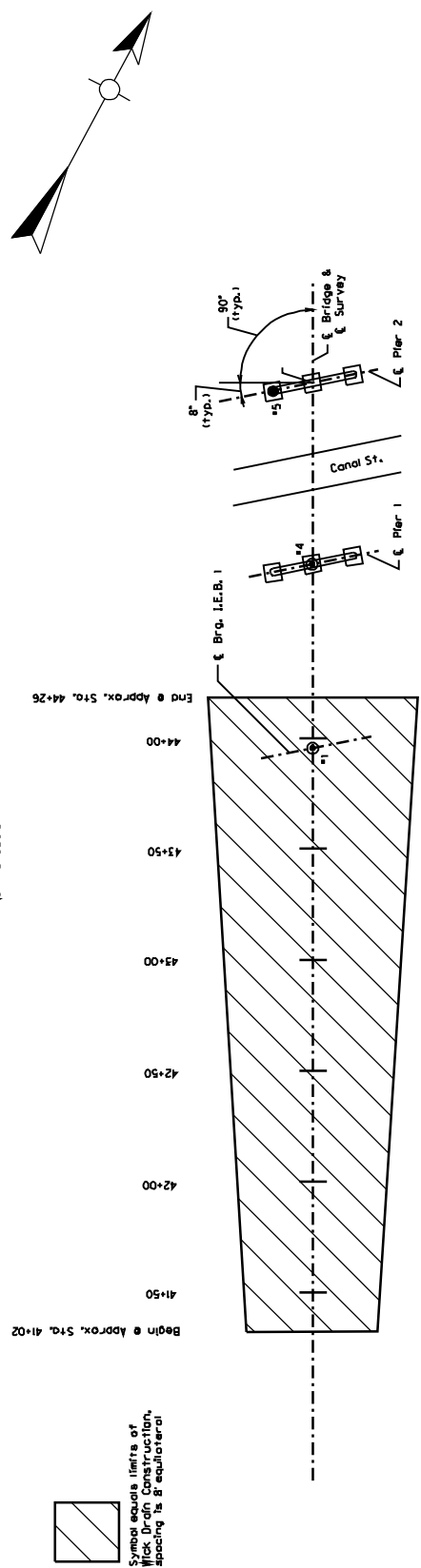
PREPARED BY _____
CHECKED BY _____
DATE _____

APPROVED BY _____
DATE _____

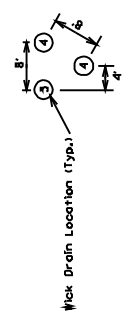
Call Number: 4401
RD: 444-1771
Hwy: 401

COUNTY OF	ITEM NO.	SHEET NO.
SPRINGFIELD	13-765.00	

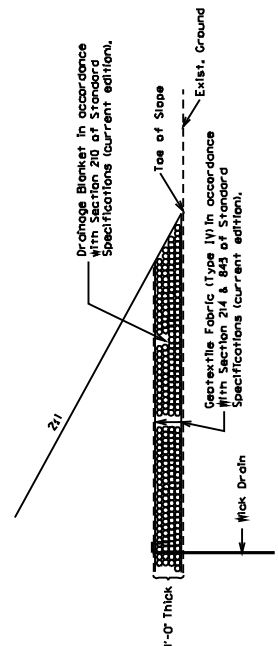
WICK DRAIN LAYOUT Not To Scale



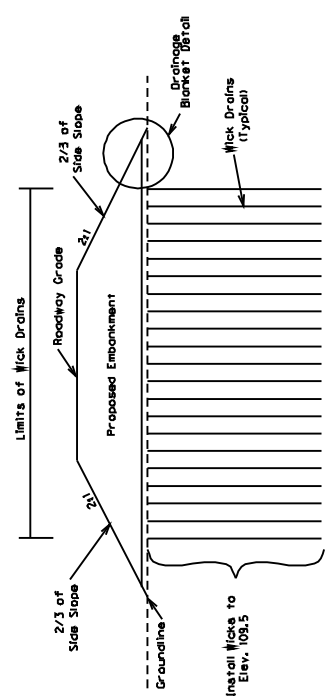
PLAN VIEW - WICK DRAIN LOCATIONS DETAIL - TRIANGULAR SPACING NOT TO SCALE



DRAINAGE BLANKET DETAIL Not To Scale



TYPICAL SECTION - WICK DRAINS Not To Scale



KENTUCKY

DEPARTMENT OF HIGHWAYS

COUNTY OF

SPRINGFIELD

PROJECT

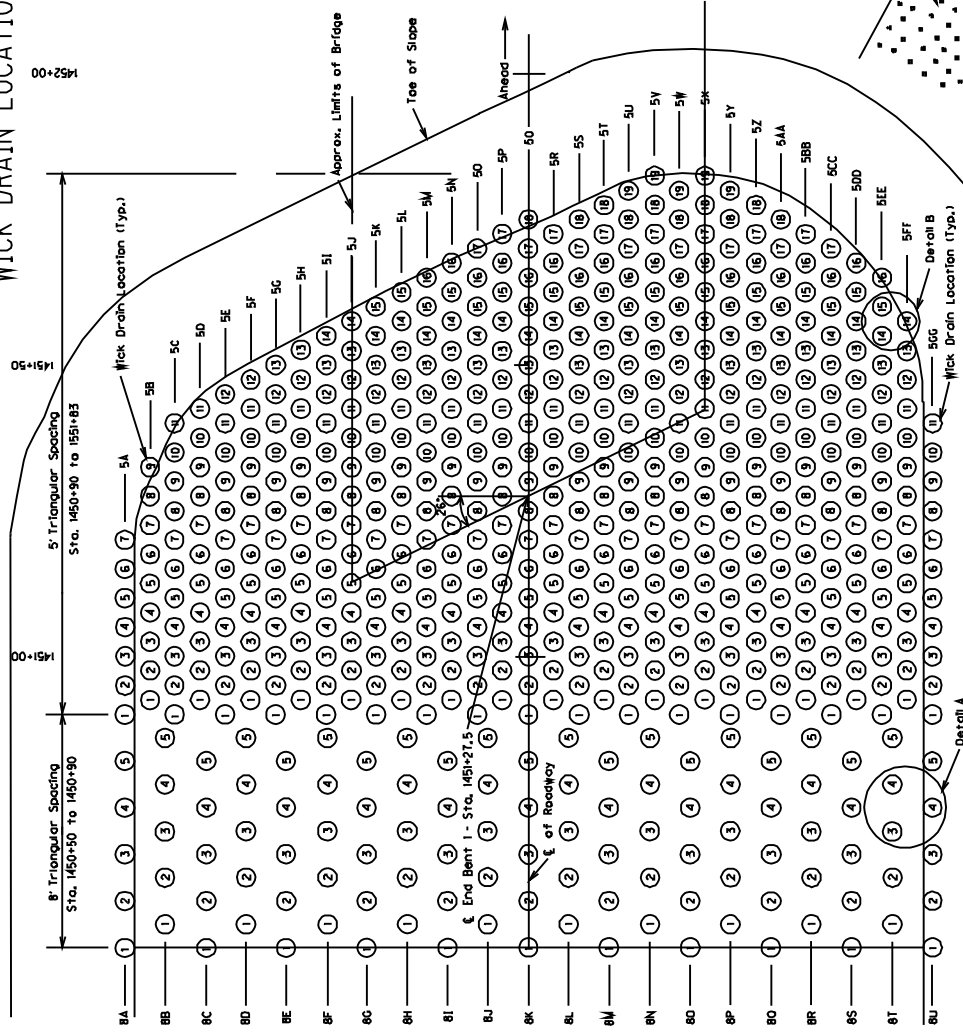
NUMBER

WICK DRAIN DETAILS

PREPARED BY	DATE
CHECKED BY	DATE
APPROVED BY	DATE

CDL 13-765.00
CDL 13-765.00
CDL 13-765.00

WICK DRAIN LOCATIONS

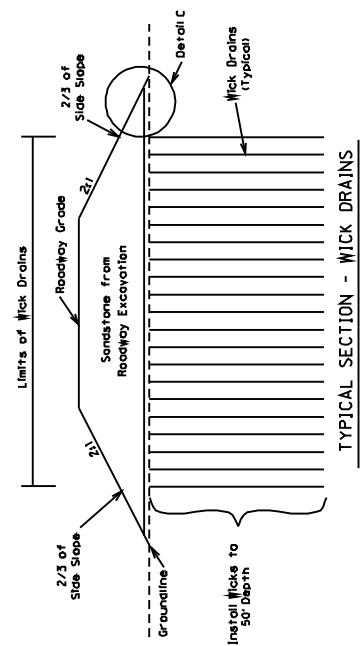


5' TRIANGULAR WICK DRAIN SPACINGS

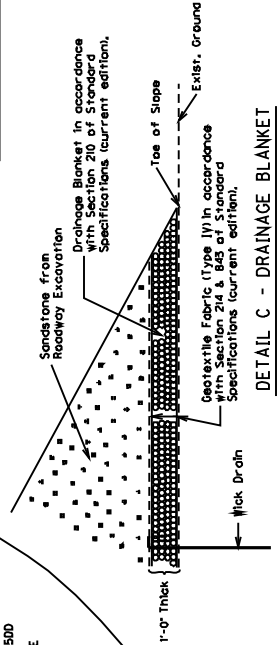
ROW	OFFSET LEFT OF C (FT.)	ROW	OFFSET RIGHT OF C (FT.)
5A	69.3	5R	4.3
5B	65.0	5S	8.7
5C	60.6	5T	13.0
5D	56.3	5U	17.3
5E	52.0	5V	21.7
5F	47.6	5W	26.0
5G	43.3	5X	30.3
5H	39.0	5Y	34.6
5I	34.6	5Z	39.0
5J	30.3	5AA	43.3
5K	26.0	5BB	47.6
5L	21.7	5CC	52.0
5M	17.3	5DD	56.3
5N	13.0	5EE	60.6
5O	8.7	5FF	65.0
5P	4.3	5GG	69.3
5Q	0.0	-	-

8' TRIANGULAR WICK DRAIN SPACINGS

ROW	OFFSET LEFT OF C (FT.)	ROW	OFFSET RIGHT OF C (FT.)
8A	69.3	8L	6.9
8B	62.4	8M	13.9
8C	55.4	8N	20.8
8D	48.5	8O	27.7
8E	41.6	8P	34.6
8F	34.6	8Q	41.6
8G	27.7	8R	48.5
8H	20.8	8S	55.4
8I	13.9	8T	62.4
8J	6.93	8U	69.3
8K	0.0	-	-



TYPICAL SECTION - WICK DRAINS



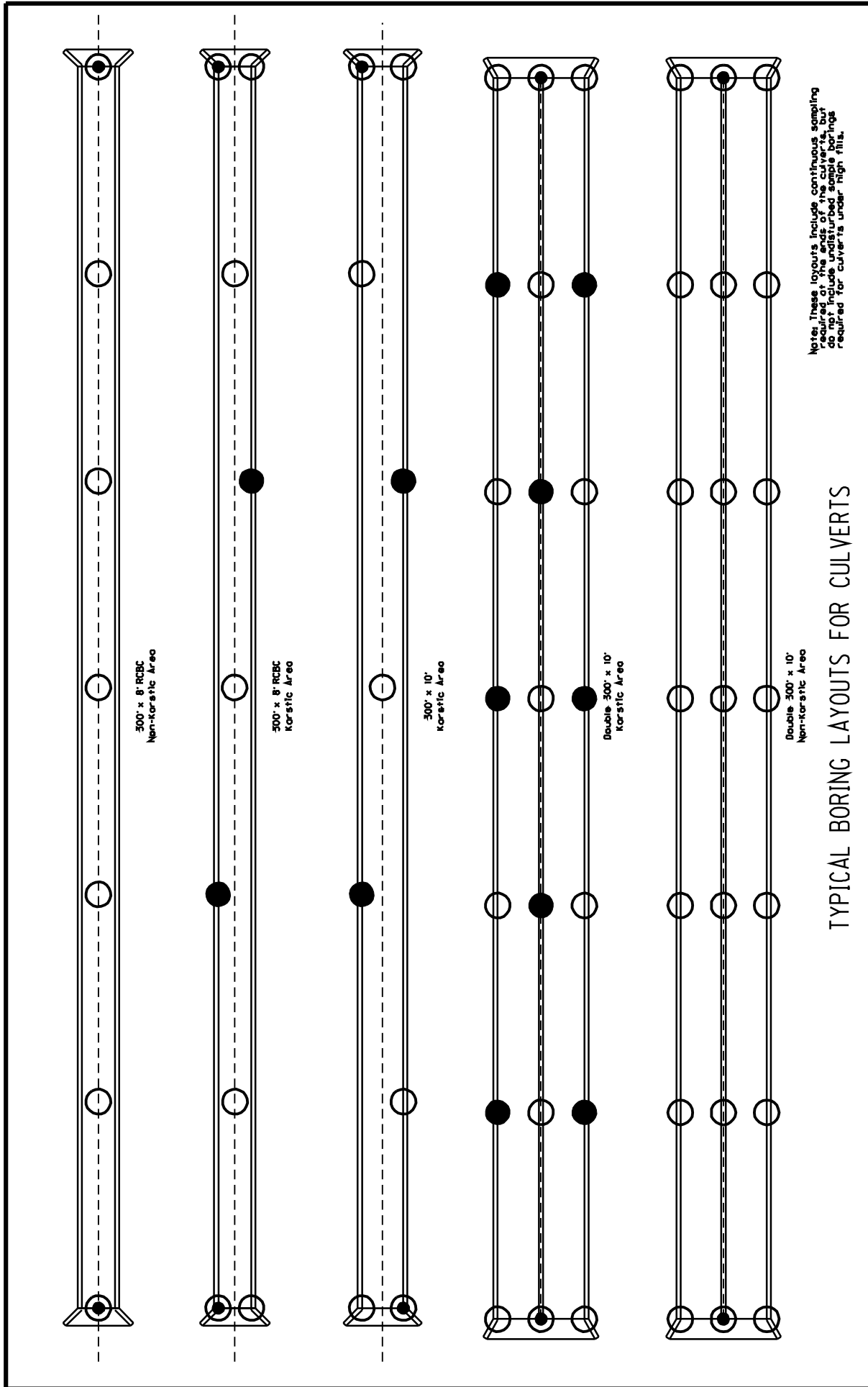
DETAIL C - DRAINAGE BLANKET

PLAN VIEW - WICK DRAIN LOCATIONS



DETAIL A - TRIANGULAR SPACING

DETAIL B - 5' TRIANGULAR SPACING



GEOTECHNICAL NOTES
for MSE Walls

If the Contractor elects to use on MSE Wall as allowed by the Contract Documents, design the wall (or walls) in accordance with the AASHTO Standard Specifications for Highway Bridges. The Contract Documents contain where a requirement which is not covered by, or is contrary to, AASHTO exists.

Use only MSE Walls with inextensible reinforcement.

Granular replacement depths (D) versus wall height (H).
For H < 10 ft, D = 0.
For H > 10 ft and <= 20 ft, D = 2.0 ft.

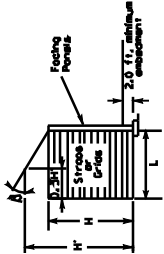
Station Interval	Bearing Surface	Allowable Bearing Capacity
10+20 - 11+15	Soil	- ksf
11+15 - 12+15	Gran. Repl.	- ksf

Use the following soil strength parameters for design.

	Cohesion (psf)	Friction Angle (degrees)	Unit Weight (pcf)
Internal Backfill (in reinforced volume)	0	34	115
External Backfill	-	-	-
Soil Embankment	-	-	-
Granular Embankment	-	-	-
Foundation Soils	-	-	-
Existing	-	-	-
Granular Replacement	-	-	-

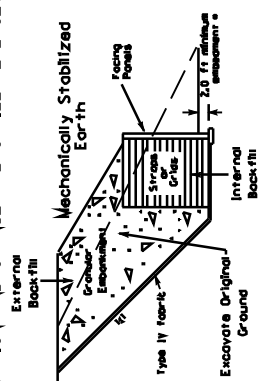
where granular replacement of existing foundation materials is required, excavate the existing foundation soil and replace with granular material as shown below. Use granular material meeting the requirements of granular embankment in Section 805 of the Standard Specifications, current edition, except that the maximum size is 4 inches. Use material that is classified as non-erodible, as defined in Section 805 of the Standard Specifications, current edition. Place Type IV fabric in accordance with Sections 24 and 843 of the Standard Specifications, current edition, as shown below.

where external granular backfill is required, place granular material as shown below. Use granular material meeting the requirements of granular embankment in Section 805 of the Standard Specifications, current edition, except that the maximum size is 4 inches. Use material that is classified as non-erodible, as defined in Section 805 of the Standard Specifications, current edition. Place Type IV fabric in accordance with Sections 24 and 843 of the Standard Specifications, current edition, as shown below.

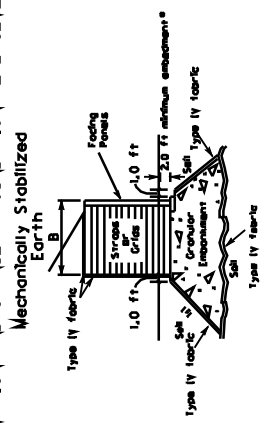


The minimum reinforcement length (L) shall be the greater of:
L > 0.7 H (where H is the effective wall height)
L > 8 ft
L = H + 0.3 for β > 1 for sloping backfill
H + 4 for level backfill

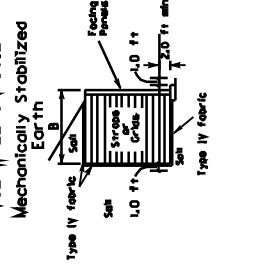
EXCAVATION AND GRANULAR BACKFILL REPLACEMENT



EXCAVATION AND GRANULAR FOUNDATION REPLACEMENT



MSE WALL ON SOIL



Type IV fabric required only where there is a soil-granular material interface.

- Unless Otherwise Noted

REVISION	DATE
25-SEPTEMBER-2004	CHECKED BY
DESIGNED BY	J. WILSON
DETAILED BY	J. WILSON
Department of Kentucky	
DEPARTMENT OF HIGHWAYS	
COUNTY	
SPRINGFIELD	
PROJECT	
US 865	
SHEET NO.	
S-005-04	
ITEM NUMBER	
13-765.00	
Division of Materials	
Geotechnical Branch	
SHEET NO.	
000000	

GEOTECHNICAL NOTES

for Granular Replacement at Reinforced Concrete Cantilever Retaining Walls

The minimum embedment shall be 2 ft. to the bottom of footing for cast in place walls.

As required by AASHTO, footings constructed on slopes shall be embedded sufficiently to provide the minimum horizontal distance of 4.0 ft., measured at top of footing, between the rear face of the footing and the face of the finished slope.

The minimum factor of safety for sliding shall be either 1.5 neglecting passive resistance or 2.0 considering passive resistance.

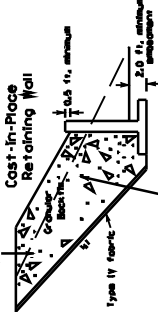
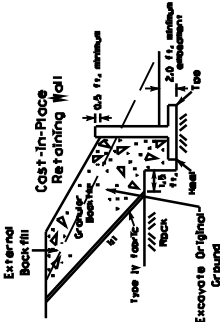
Granular replacement depths (D) versus wall height (H):
For H < 10 ft., D = 0
For H > 10 ft. and <= 20 ft., D = 2.0 ft.

Station Interval	Bearing Surface	Allowable Bearing Capacity
10+20 - 11+15	Soil	- ksf
11+15 - 12+15	Gran. Repl.	- ksf

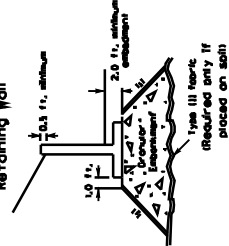
Use the following soil strength parameters for design

	Cohesion (psf)	Friction Angle (degrees)	Unit Weight (pcf)
External Backfill	-	-	-
Soil Embankment	-	-	-
Granular Embankment	-	-	-
Foundation Soils	-	-	-
Existing	-	-	-
Granular Replacement	-	-	-

EXTERNAL EXCAVATION AND BACKFILL REPLACEMENT



EXCAVATION AND GRANULAR FOUNDATION REPLACEMENT



Where granular replacement of existing foundation materials is required, excavate the existing foundation soil and replace with granular material as shown below. Use granular material meeting the requirements of 'granular embankment' in Section 805 of the Standard Specifications, current edition, except that the maximum size is 4 inches. Use material that is classified as non-erodible, as defined in Section 805 of the Standard Specifications, current edition. Place Type IV fabric in accordance with Sections 214 and 843 of the Standard Specifications, current edition, as shown below.

Where external granular backfill is required, place granular material as shown below. Use granular material meeting the requirements of 'granular embankment' in Section 805 of the Standard Specifications, current edition, except that the maximum size is 4 inches. Use material that is classified as non-erodible, as defined in Section 805 of the Standard Specifications, current edition. Place Type IV fabric in accordance with Sections 214 and 843 of the Standard Specifications, current edition, as shown below.

DATE: 25-SEPTEMBER-2004	REVISION	DATE
DESIGNED BY: J. A. MOLEN	CHECKED BY:	
DETAILED BY: J. A. MOLEN		
DEPARTMENT OF HIGHWAYS		
COMMONWEALTH OF KENTUCKY		
COUNTY: SPRINGFIELD		
SHEET: US 885		
PROJECT: DIVISION OF MATERIALS		
SUBJECT: Geotechnical Branch		

S-005-04
ITEM NUMBER
13-765.00





County _____

Road Number _____

Survey Crew / Consultant _____

Contact Person _____

Item # _____

MARS # _____

Project # _____

Date _____

Notes:

Notes:

HOLE NUMBER	STATION	OFFSET	ELEVATION (ft)	LATITUDE	LONGITUDE
01	00	00	00	00	00
02	00	00	00	00	00
03	00	00	00	00	00
04	00	00	00	00	00
05	00	00	00	00	00
06	00	00	00	00	00
07	00	00	00	00	00
08	00	00	00	00	00
09	00	00	00	00	00
10	00	00	00	00	00
11	00	00	00	00	00
12	00	00	00	00	00
13	00	00	00	00	00
14	00	00	00	00	00
15	00	00	00	00	00
16	00	00	00	00	00
17	00	00	00	00	00
18	00	00	00	00	00
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20	00	00	00	00	00
21	00	00	00	00	00
22	00	00	00	00	00
23	00	00	00	00	00
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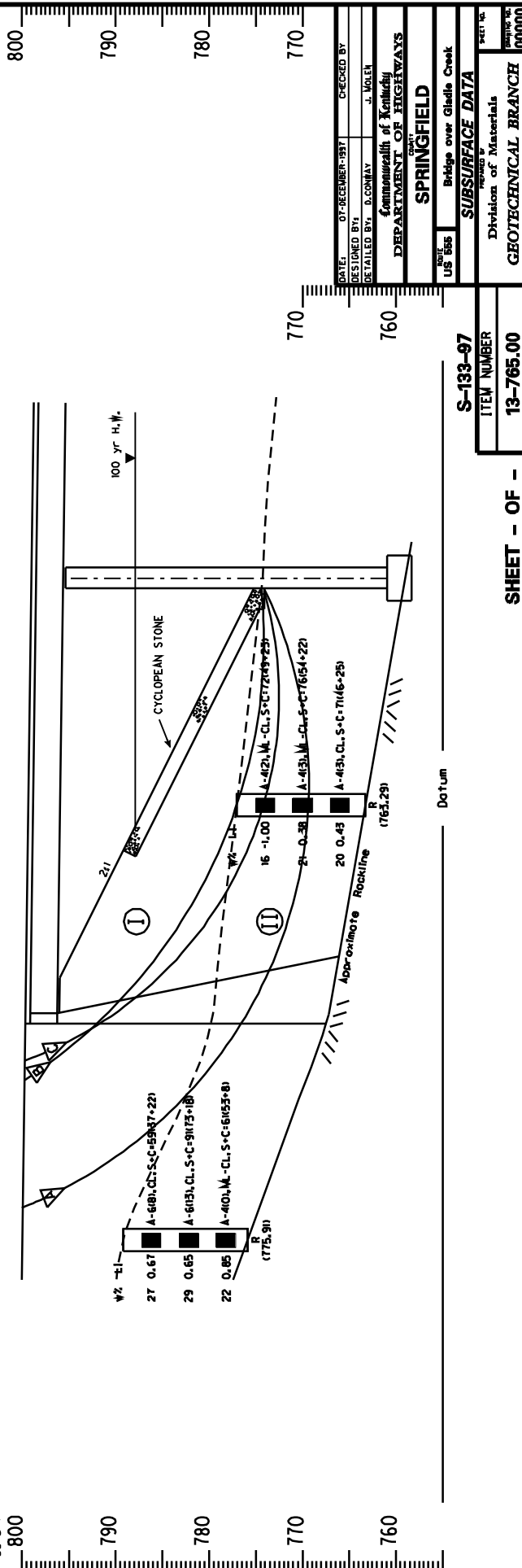
SUBSURFACE DATA

FACTORS OF SAFETY			
SHORT TERM	A	B	C
LONG TERM	A	B	C
RAID GRADE	A	B	C

ASSUMED SOIL STRENGTH PARAMETERS			
SOIL	I	II	
SHORT TERM	J = 125 pcf C = 1500 psf φ = 0°	125 pcf 1500 psf 0°	
LONG TERM	J = 125 pcf C = 250 psf φ = 28°	125 pcf 250 psf 28°	
RAID GRADE	J = 125 pcf C = 250 psf φ = 28°	125 pcf 250 psf 28°	

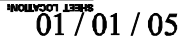
52+75.00
785.20

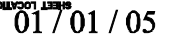
53+21.00
777.03



S-133-97
ITEM NUMBER
13-765.00

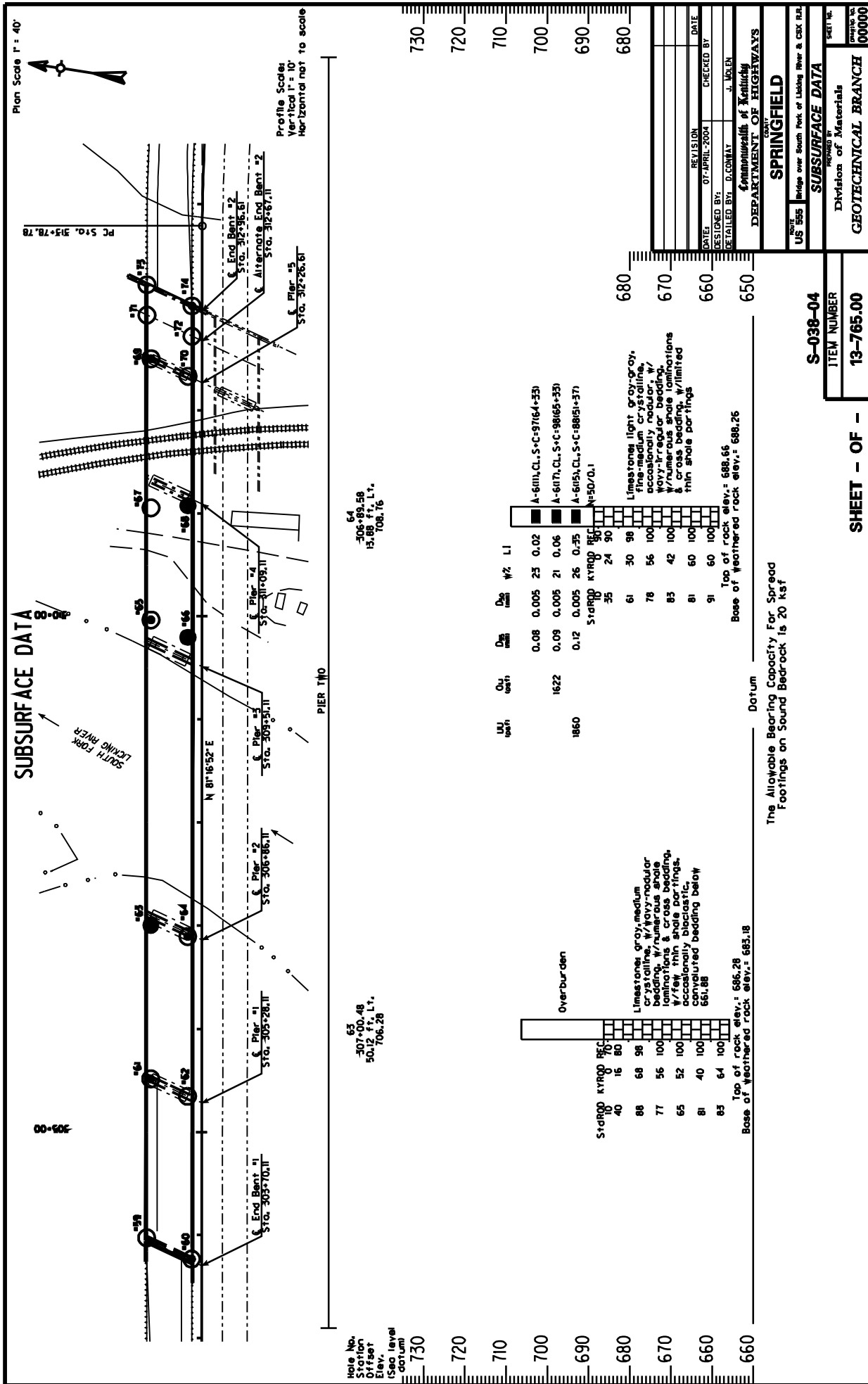
DATE: 07-16-1997	CHECKED BY: J. MOLEN
DESIGNED BY: D. CONWAY	
DEPARTMENT OF HIGHWAYS	
SPRINGFIELD	
BRIDGE over Glade Creek	
SUBSURFACE DATA	
DIVISION of Materials	
GEOTECHNICAL BRANCH	
SHEET NO. 00000	



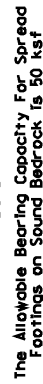




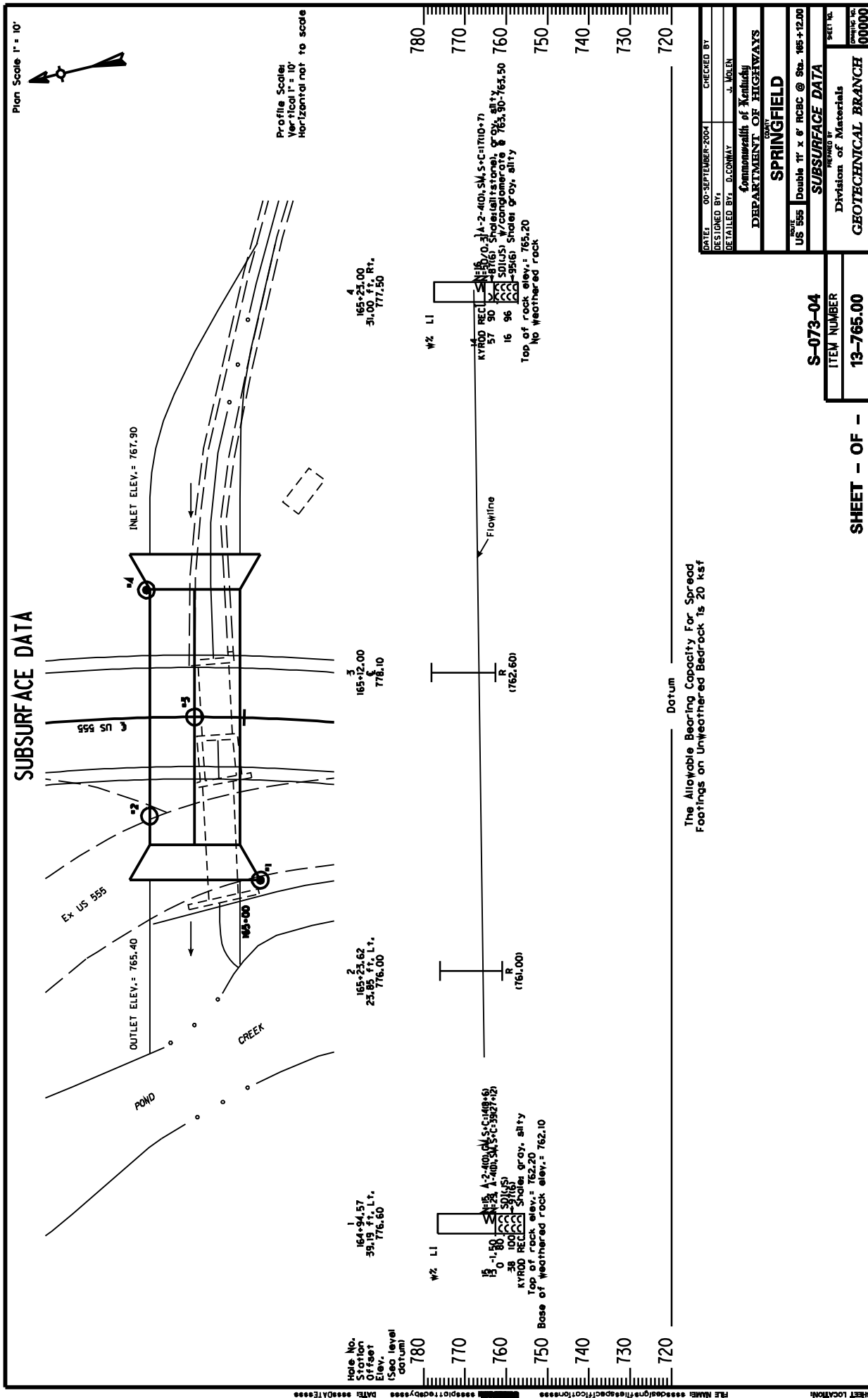




Plan Scale 1" = 10'

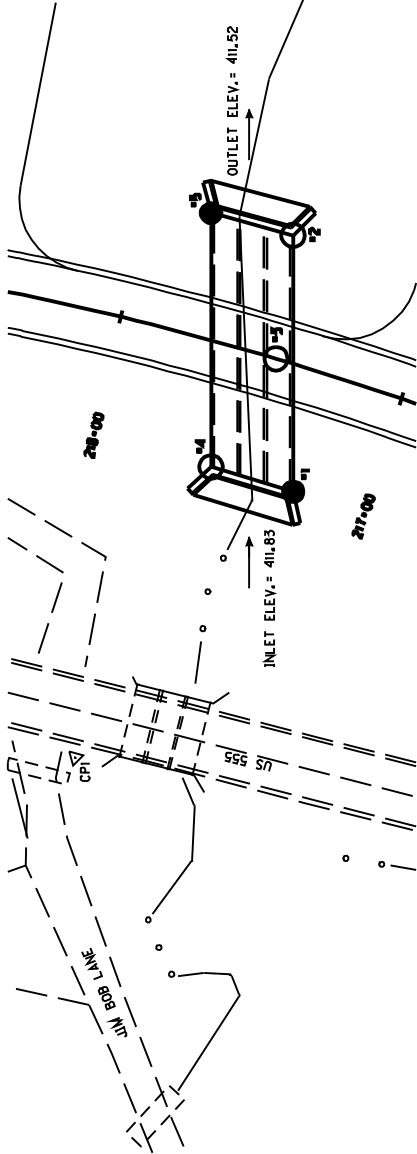


SHEET - OF -
S-062-01
ITEM NUMBER
13-765.00



SUBSURFACE DATA

Plan Scale 1" = 20'



Profile Scales
Vertical 1" = 10'
Horizontal not to scale

Note No.
Station
Offset
Elev.
(Sea level
datum)



1
217+25.67
41.55 ft. L.t.
415.68

2
217+54.01
41.38 ft. R.t.
417.11

3
217+44.91
41.54
417.54

4
217+55.12
41.50 ft. L.t.
416.25

5
217+78.95
41.95 ft. R.t.
414.80

Q4
L1



Q4
L1



Datum

360

360

370

380

390

400

410

420

DATE:	31-OCTOBER-2004	CHECKED BY:	
DESIGNED BY:	D.COMLEY	J. MOLEN	
DETAILED BY:			
Commonwealth of Kentucky			
DEPARTMENT OF HIGHWAYS			
SPRINGFIELD			
PROJECT NO.	US 555	TRIPLE 8' x 8' RCBC @ Sta. 217+53.41	
SUBSURFACE DATA			
DIVISION OF MATERIALS			
SHEET NO.			
GEOTECHNICAL BRANCH			
00000			

S-033-04

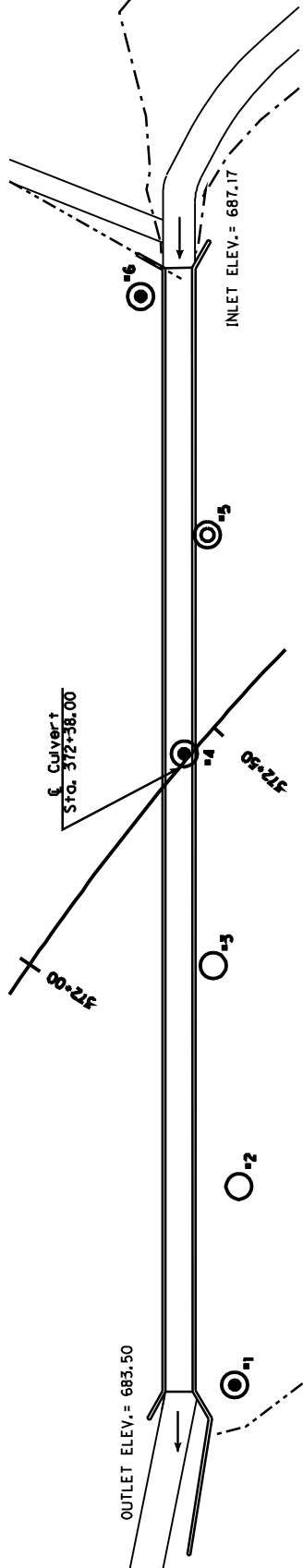
ITEM NUMBER

13-765.00

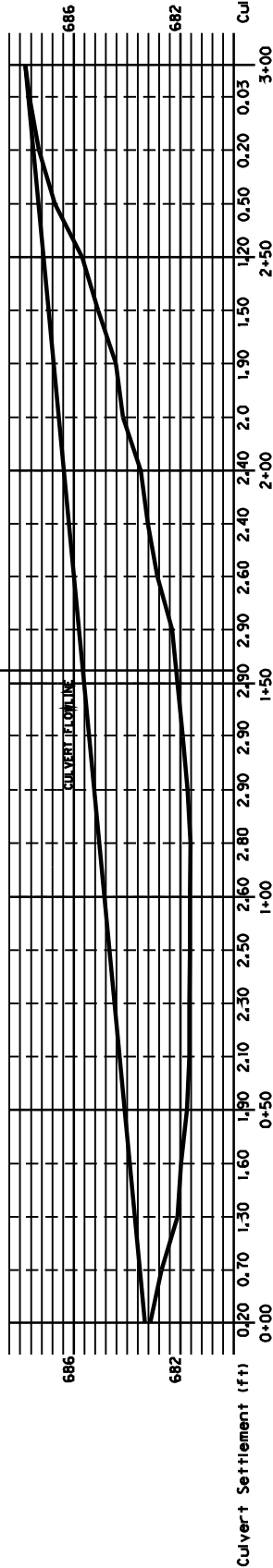
SHEET - OF -

TYPICAL SETTLEMENT PLOT

Plan Scale 1" = 10'



§ Proposed Embankment



DATE:	06-MAY-1998	CHECKED BY:	J. MOLEN
DESIGNED BY:	D. COMBAY	COMMUNITY OF KENTUCKY	
DETAILED BY:		DEPARTMENT OF HIGHWAYS	
		SPRINGFIELD	
		11' x 8' RCBC @ Sta. 372+38.00	
		SETTLEMENT PLOT	
		Division of Materials	
		GEOTECHNICAL BRANCH	
		000000	

S-082-98

ITEM NUMBER

13-765.00

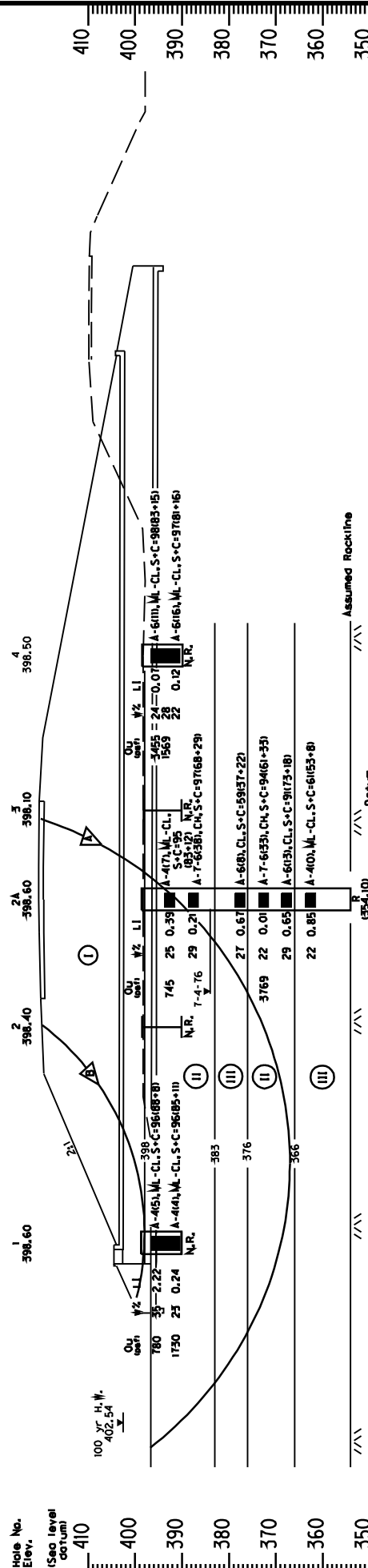
SHEET - OF -

SUBSURFACE DATA

FACTORS OF SAFETY		
A	Short Term	2.8
B	Long Term	2.2

ASSUMED SOIL STRENGTH PARAMETERS				
Soil	I	II	III	
Unit Weight	125	120	120	
Short Term	c (pcf)	c = 1500	c = 1200	c = 1800
Term	φ (deg.)	φ = 0°	φ = 0°	φ = 0°
Long Term	c (pcf)	c = 200	c = 400	c = 200
Term	φ (deg.)	φ = 28°	φ = 28°	φ = 32°

Profile Scales
Vertical 1" = 10'
Horizontal not to scale



SUMMARY OF CONSOLIDATED UNDRAINED TRIAXIAL TEST			
Soil	2A	4	
Depth	5'-7"	2'-4"	
σ _v	16'-2"	6'-6"	
σ _h	25'-2"	6'-0"	
σ ₁	40'	35.3'	

DATE: 31-OCTOBER-2004	CHECKED BY: J. MOLEN
DESIGNED BY: D. CONWAY	
DETAILED BY: J. MOLEN	
Commonwealth of Kentucky DEPARTMENT OF HIGHWAYS	
COUNTY: SPRINGFIELD	
ROUTE: US 555	8' x 8' RCBC @ Sta. 09+56.41
SUBSURFACE DATA	
DIVISION OF MATERIALS	
GEOTECHNICAL BRANCH	

S-028-04
ITEM NUMBER
13-765.00
SHEET - OF -

KENTUCKY TRANSPORTATION CABINET
Division of Materials
Geotechnical Branch

TC 64-522
Rev. 5/05

PERFORMANCE EVALUATION FOR GEOTECHNICAL SERVICES

County _____ Roadway Name _____ Mars No. _____

Project No. _____ Item No. _____

Drilling Company _____ Geotechnical Engr. Consultant _____

Contract Completion Date _____

Actual Completion Date _____

INSTRUCTIONS: Check one of the three boxes. Unless the "not applicable" box is checked, circle one of the relative performance numbers, where 5 is the best performance and 1 is the worst.

	Satisfactory	Relative Performance Scale					Unsatisfactory	Not Applicable
Drilling and Sampling	<input type="checkbox"/>	5	4	3	2	1	<input type="checkbox"/>	<input type="checkbox"/>
Laboratory Testing	<input type="checkbox"/>	5	4	3	2	1	<input type="checkbox"/>	<input type="checkbox"/>
Engineering Analysis	<input type="checkbox"/>	5	4	3	2	1	<input type="checkbox"/>	<input type="checkbox"/>
Engineering Report	<input type="checkbox"/>	5	4	3	2	1	<input type="checkbox"/>	<input type="checkbox"/>
Time of Completion	<input type="checkbox"/>	5	4	3	2	1	<input type="checkbox"/>	<input type="checkbox"/>
Amount of State Supervision Required	<input type="checkbox"/>	5	4	3	2	1	<input type="checkbox"/>	<input type="checkbox"/>

WORK CRITIQUE: (Explain any reasons for rating below 3)

Evaluated By (Please Print)

Name _____

Title _____

Signature _____

Date _____

CC: Geotech (Project File)
Geotech (Consultant File)

KENTUCKY TRANSPORTATION CABINET
Division of Materials
Geotechnical Branch

TC 64-540
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Page 1 of 4

**PREQUALIFICATION REQUIREMENTS
FOR GEOTECHNICAL DRILLING SERVICES**

I. Experience

The vendor must provide evidence of experience in the last 5 years performing drilling services for highway projects (roadways and bridges). The evidence shall include projects illustrating this type of experience, with references (agency, project engineer, or consultant) with addresses and phone numbers.

II. Equipment

The vendor must provide a list of available equipment (drill rigs and accessories) for soil sampling and rock coring. The vendor must have at least one drill rig equipped with an automatic hammer in order to be prequalified.

III. Personnel

Drill crew supervisors must be experienced in obtaining rock cores for rock cut slope and bridge foundation design, performing rock line soundings, performing standard penetration tests, obtaining thin-walled tube samples, obtaining disturbed soil samples, and installing cased observation wells. Evidence must be provided that the drill crew supervisors have a minimum of 3 years experience in the above-mentioned operations for highway projects (roadways and bridges). A drill crew supervisor is defined as the person on the drill crew field party who is responsible for the drilling operations mentioned above.

IV. Insurance

Worker's Compensation and Liability Insurance as required by the Division of Professional Services.

Notes:

1. Complete Pages 2 - 4 of this form. Pages 3 and 4 should reflect equipment and personnel that will be used on Kentucky highway projects. Provide personal history statements for drill crew supervisors included on Page 4.
2. Attach proof of the above-referenced insurances.

SUMMARY OF HIGHWAY PROJECTS COMPLETED

[illegible]

KENTUCKY TRANSPORTATION CABINET
Division of Materials
Geotechnical Branch

TC 64-540
Rev. 5/05
Page 3 of 4

SUMMARY OF DRILLING EQUIPMENT

1. Drill Rigs

Type (truck, skid, or track)	Make	Model	Year
Type (truck, skid, or track)	Make	Model	Year
Type (truck, skid, or track)	Make	Model	Year
Type (truck, skid, or track)	Make	Model	Year

2. Core Barrels

Type (wireline or conventional)	Diameter	Length
Type (wireline or conventional)	Diameter	Length
Type (wireline or conventional)	Diameter	Length
Type (wireline or conventional)	Diameter	Length

3. Standard Penetration Hammers

Type (standard, safety, or automatic)
Type (standard, safety, or automatic)
Type (standard, safety, or automatic)
Type (standard, safety, or automatic)

4. Split Barrel Samplers

Diameter	Length	Type of Shoe
Diameter	Length	Type of Shoe
Diameter	Length	Type of Shoe
Diameter	Length	Type of Shoe

5. Thin-Walled Tube Samplers

Diameter	Length
Diameter	Length
Diameter	Length
Diameter	Length

6. List other equipment such as pumps, augers (hollow or solid), casing, floating equipment (barge), etc. Please use additional sheets as necessary.

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SUMMARY OF DRILLING PERSONNEL EXPERIENCE

[illegible]

Provide personal history statements for Drill Crew Supervisors.

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TC 64-541
Rev. 5/05
Page 1 of 3

**PREQUALIFICATION REQUIREMENTS
FOR GEOTECHNICAL ENGINEERING SERVICES**

I. Firm Requirements

- A. A firm permit issued by the Kentucky Board of Licensure for Professional Engineers and Land Surveyors.
- B. Sufficient geotechnical engineering experience by the firm, as demonstrated by having performed geotechnical engineering on a minimum of 3 transportation projects (or other projects where related engineering tasks were performed) in the last 5 years.
- C. MicroStation CADD Software.

II. Personnel Requirements

- A. At least one Professional Engineer licensed in Kentucky with a minimum of 3 years of geotechnical engineering experience applicable to the design and/or construction of highway facilities (demonstrated by performing tasks included on Page 3 of this form). The firm will be required to assign at least one person meeting these requirements to actively participate in KYTC geotechnical projects in the capacity of Project Manager, Project Engineer, etc.
- B. At least one Professional Geologist licensed in Kentucky with a minimum of 3 years of engineering geology experience applicable to the design and/or construction of highway facilities (demonstrated by performing tasks included on Page 3 of this form).
- C. Staff with sufficient experience to perform geotechnical engineering tasks for KYTC, as demonstrated by experience in a minimum of 9 of the 12 areas of "conventional" experience included on Page 3 of this form. (Seismic experience is not required.)
- D. A minimum of one CADD operator proficient with Microstation.

Notes:

- 1. Complete Page 2 of this form and provide detailed project descriptions for a minimum of 3 of the projects completed by the firm included in the summary.
- 2. Complete Page 3 of this form and provide resumes of personnel needed to meet the personnel requirements above. All personnel experience need not be with the current employer.
- 3. A firm may subcontract laboratory testing and/or field drilling operations to firms prequalified in the applicable area(s). A firm may also subcontract speciality work in areas not covered by prequalification. All subcontracting is subject to the prior approval of the Division of Professional Services and the Geotechnical Branch.
- 4. For details regarding Licensure and Firm Permits, refer to:
KY Board of Licensure for Professional Engineers and Land Surveyors <http://kyboels.ky.gov/>
KY Board of Registration for Professional Geologists <http://finance.ky.gov/ourcabinet/caboff/OAS/op/progeo/>

KENTUCKY TRANSPORTATION CABINET

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Page 2 of 3

SUMMARY OF TRANSPORTATION (OR RELATED) PROJECTS COMPLETED
IN THE LAST 5 YEARS FOR WHICH THE FIRM PROVIDED GEOTECHNICAL ENGINEERING SERVICES

Project Name	Project Location (County & State)	Description of Work Performed	Dates Performed	Key Personnel	Client (Include Address & Phone)	Approximate Fee

Provide detailed project descriptions for a minimum of 3 project

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**PREQUALIFICATION REQUIREMENTS
FOR GEOTECHNICAL LABORATORY TESTING SERVICES**

- A. Accreditation by the AASHTO Materials Reference Laboratory (AMRL) for the following AASHTO Test Methods: T87, T88, T89, T90, T99, T100, T193, T208, and T265. The Geotechnical Branch will verify accreditation on the AMRL website during the prequalification review.
- B. Management and staff meeting the requirements for AASHTO R18 accreditation and with experience performing all the above-referenced tests.
- C. A loading device with a movable head or base such that it is capable of applying a compressive load up to 60,000 lb. (267 kN), as required for the compaction portion of KM 64-501 (the Kentucky Method for performing the California Bearing Ratio Test).

NOTES:

- 1. Complete Page 2 of this form and provide resumes of key personnel identified in the laboratory's Quality Manual (e.g. Technical Manager, Supervising Laboratory Technician, and Quality Manager).
- 2. Identify the location(s) of lab(s) to be used on KYTC projects.
- 3. Provide a description and laboratory location of the above-referenced loading device. Include the make, model, load capacity, etc., and a statement that it meets the requirements above. This device must be located at a laboratory that is accredited for AASHTO T193.
- 4. In addition to the above-referenced test methods, the Geotechnical Branch considers AMRL accreditation for T216, T296, and T297, and the capability to perform the Unconfined Compressive Strength of Rock, Slake Durability, and Jar Slake tests to be highly desirable. Although these tests are not required for prequalification, the Geotechnical Branch strongly recommends that labs be accredited for and/or have the ability to perform these tests.
- 5. Although not generally required to be submitted for prequalification, the Geotechnical Branch may request accreditation documents such as the Quality Manual, On-Site Assessment Reports, Proficiency Sample Test Results, etc. Please be prepared to provide such documents upon request.
- 6. For details regarding laboratory accreditation, refer to:
AASHTO Materials Reference Laboratory <http://www.amrl.net/>

SUMMARY OF GEOTECHNICAL LABORATORY PERSONNEL EXPERIENCE

[illegible]

Include only personnel in lab(s) to be used on KYTC project:
Provide the resumes of key personnel identified in the lab's Quality Manual

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KENTUCKY TRANSPORTATION CABINET
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Geotechnical Branch

UNIT COST ITEMS FOR GEOTECHNICAL SERVICES

COUNTY	ITEM #		MARS #	
REGION #	RANK	CONTRACT #	ESTIMATE #	
		UNIT PRICE	UNITS	TOTAL
1. Rock Coring		\$ _____ per foot	x _____ =	\$ _____
2. Rock Coring on Floating Eq.		\$ _____ per foot	x _____ =	\$ _____
3. Rock Sounding		\$ _____ per foot	x _____ =	\$ _____
4. Rock Sounding on Floating Eq.		\$ _____ per foot	x _____ =	\$ _____
5. Visual Inspection & Logging Rock Exposure		\$ _____ per foot	x _____ =	\$ _____
6. Disturbed Soil Boring		\$ _____ per foot	x _____ =	\$ _____
7. Bag Sample		\$ _____ per sample	x _____ =	\$ _____
8. Standard Penetration Test		\$ _____ per test	x _____ =	\$ _____
9. Standard Penetration Test on Floating Eq.		\$ _____ per test	x _____ =	\$ _____
10. Thin-Walled Tube Sample		\$ _____ per tube	x _____ =	\$ _____
11. Thin-Walled Tube Sample on Floating Eq.		\$ _____ per tube	x _____ =	\$ _____
12. Field Vane Shear Test		\$ _____ per test	x _____ =	\$ _____
13. Field Vane Shear Test on Floating Eq.		\$ _____ per test	x _____ =	\$ _____
14. Cased Observation Well		\$ _____ per well	x _____ =	\$ _____
15. Drill Hole for Slope Inclinator Casing		\$ _____ per foot	x _____ =	\$ _____
16. Pavement Cores		\$ _____ per foot	x _____ =	\$ _____
17. Grouting Intervals, 6 Inch Auger		\$ _____ per foot	x _____ =	\$ _____
18. Grouting Intervals, 4 Inch Auger		\$ _____ per foot	x _____ =	\$ _____
19. Grouting Intervals, Rock Core		\$ _____ per foot	x _____ =	\$ _____
20. Moisture Content Sample		\$ _____ per sample	x _____ =	\$ _____
21. Moisture Content Test		\$ _____ per test	x _____ =	\$ _____
22. Logging Rock Core		\$ _____ per foot	x _____ =	\$ _____
23. Soil Classifications		\$ _____ per sample	x _____ =	\$ _____

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KENTUCKY TRANSPORTATION CABINET
Division of Materials
Geotechnical Branch

UNIT COST ITEMS FOR GEOTECHNICAL SERVICES

COUNTY	ITEM #	
24. Wash and Sieve Gradations	\$ per test x = \$	
25. Moisture/Density/CBR/Soil Classification	\$ per sample x = \$	
26. Moisture/Density Test	\$ per sample x = \$	
27. Slake Durability Index & Jar Slake Test	\$ per test x = \$	
28. Unconfined Compression Tests on Soil	\$ per test x = \$	
29. Unconfined Compression Tests on Rock	\$ per test x = \$	
30. One-Dimensional Consolidation Tests	\$ per test x = \$	
31. Consolidated-Undrained Triaxial Test with Pore Pressure Measurements	\$ per test x = \$	
32. Unconsolidated-Undrained Triaxial Test Total Stress Method	\$ per test x = \$	
33. Slope Stability Analyses	\$ per analysis x = \$	
34. Settlement Analyses	\$ per analysis x = \$	
35. Deep Foundation Analyses	\$ per analysis x = \$	
36. Wave Equation Driveability Analyses	\$ per analysis x = \$	
37. Negative Skin Friction Analyses	\$ per analysis x = \$	
38. Bearing Capacity Analyses	\$ per analysis x = \$	
39. Retaining Wall Analyses	\$ per section x = \$	
40. Drafting	\$ per sheet x = \$	
41. Dozer Working Time	\$ per hour x = \$	
42. Track Hoe Working Time	\$ per hour x = \$	
43. Mobilization/Demobilization of Drill Eq.	\$ per mile x = \$ + (FIXED FEE) + \$	
44. Mobilization/Demobilization of Subcontracted Dozer or Track Hoe	\$ per hour x 2 = \$	
45. Mobilization/Demobilization of Company Owned Dozer or Track Hoe	per mile x = \$ + (FIXED FEE) + \$	

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KENTUCKY TRANSPORTATION CABINET

Division of Materials
Geotechnical Branch

UNIT COST ITEMS FOR GEOTECHNICAL SERVICES

COUNTY	ITEM #					
	46. Mobilization/Demobilization of Company Owned Floating Equipment	\$	lump sum	x		= \$
	47. Towboat and /or Barge & its crew (Subcontracted)	\$	per invoice	x		= \$
				+	(FIXED FEE)	+ \$
	48. Towboat and /or Barge & its crew (In-House)	\$	per day	x		= \$
				+	(FIXED FEE)	+ \$
	49. Reclamation : Activity	\$	per day	x		= \$
	50. Reclamation : Material Cost	\$	per invoice	+	10%	= \$
	51. Traffic Control (In-House)	\$	per day	x		= \$
	52. Subcontracted Traffic Control	\$	per invoice	+	10%	= \$
	53. Preliminary Plans	\$	lump sum	x		= \$
	54. Preliminary Meetings	\$	lump sum	x		= \$
	55. Rock Core Meetings	\$	lump sum	x		= \$
	56. Interim Meetings	\$	lump sum	x		= \$
	57. Final Meetings	\$	lump sum	x		= \$
	58. Report Writing	\$	lump sum	x		= \$
	59. Publication of Reports	\$	lump sum	x		= \$
					TOTAL THIS ESTIMATE	= \$
ACCUMULATED TOTAL ESTIMATES			THROUGH			= \$

FIRM NAME

SIGNED

DATE

TABULATION OF QUANTITIES FOR INVOICES

[illegible]

TABULATION OF QUANTITIES FOR INVOICES

[illegible]

TABULATION OF QUANTITIES FOR INVOICES

[illegible]

KENTUCKY TRANSPORTATION CABINET
Division of Materials
Geotechnical Branch

TC 64-523

NOTIFICATION FOR DRILLING SERVICES

VENDOR:

SUBJECT: Drilling Services

Region #
Agreement #
Contract Rank:

COUNTY:

PROJECT #:

MARS #:

ITEM #:

ROAD NAME:

Type of Drilling Services:

DATE OF NOTIFICATION:

DATE TO COMPLETE: _____

TIME TO COMPLETE: _____ Calendar Days from Date of Notification

Signed:

Department Representative

Date

Project Accepted:

☐

Yes

☐

No

Signed:

Vendor Representative

Date

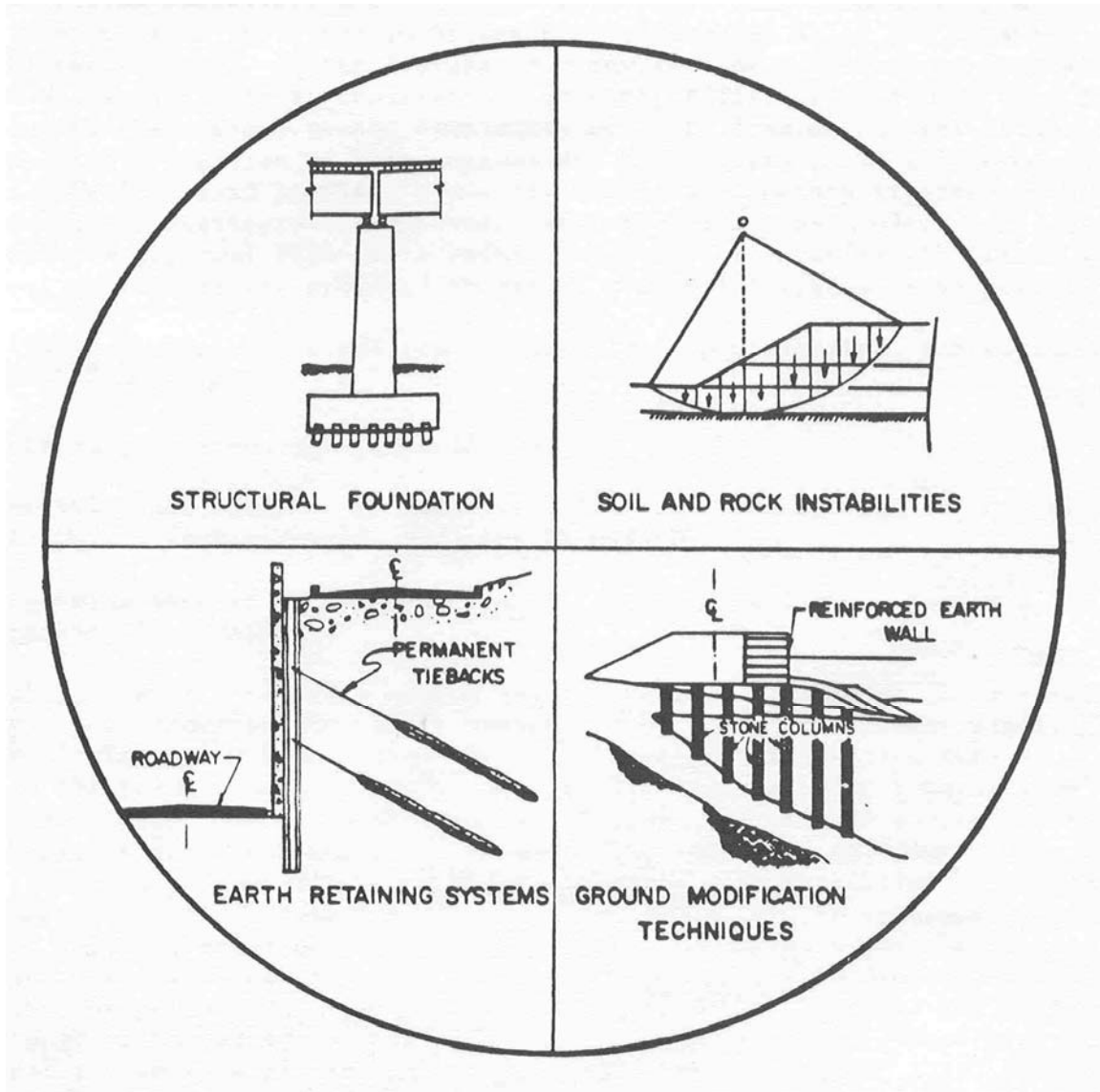


U.S. Department
of Transportation
**Federal Highway
Administration**

Publication No. FHWA ED-88-053

August 1988

Revised February 2003



CHECKLIST AND GUIDELINES FOR REVIEW OF GEOTECHNICAL REPORTS AND PRELIMINARY PLANS AND SPECIFICATIONS

PREFACE

A set of review checklists and technical guidelines has been developed to aid engineers in their review of projects containing major and unusual geotechnical features. These features may involve any earthwork or foundation related activities such as construction of cuts, fills, or retaining structures, which due to their size, scope, complexity or cost, deserve special attention. A more specific definition of both unusual and major features is presented in Table 1. Table 1 also provides a description of a voluntary program by which FHWA generalists engineers determine what type and size projects may warrant a review by a FHWA geotechnical specialist. The review checklists and technical guidelines are provided to assist generalist highway engineers in:

- Reviewing both geotechnical reports and plan, specification, and estimate (PS&E)* packages;
- Recognizing cost-saving opportunities
- Identifying deficiencies or potential claim problems due to inadequate geotechnical investigation, analysis or design;
- Recognizing when to request additional technical assistance from a geotechnical specialist.

At first glance, the enclosed review checklists will seem to be inordinately lengthy, however, this should not cause great concern. First, approximately 50 percent of the review checklists deal with structural foundation topics, normally the primary responsibility of a bridge engineer; the remaining 50 percent deal with roadway design topics. Second, the general portion of the PS&E checklist is only one page in length. The remaining portions of the PS&E checklist apply to specific geotechnical features – such as pile foundations, embankments, landslide corrections, etc., and would only be completed when those specific features exist on the project. Third, the largest portion of the checklists deals with the review of geotechnical reports, with a separate checklist for each of eight geotechnical features. The checklist for each geotechnical feature is only one to two pages in length. Therefore, on most projects, reviewers will find that only a small portion of the total enclosed checklist needs to be completed.

* For purposes of this document, PS&E refers to a plan and specification review at any time during a project's development. Hence, the review may be at a preliminary or partial stage of plan development.

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GEOTECHNICAL REVIEW CHECKLISTS AND TECHNICAL GUIDELINES

Introduction

The following review checklists and technical guidelines have been developed to aid engineers with review of geotechnical reports, plans and special provisions on projects containing major and unusual geotechnical features. These may involve any earthwork or foundation related activities such as construction of cuts, fills, or retaining structures, which due to their size, scope, complexity or cost, deserve special attention. A more specific definition of both major and unusual features is presented in Table 1. The checklists and review guidelines are intended to serve four primary purposes.

First, for projects that are submitted to a FHWA geotechnical specialist, the checklists and technical guidelines are provided to aid FHWA generalist engineers in making a quick review of the geotechnical report and accompanying support data provided by the State, to insure that the information provided by the State is complete enough to allow adequate technical review by the FHWA geotechnical specialist.

Second, for projects which will not be submitted to a FHWA geotechnical specialist for formal review (which will be the majority of projects handled by the FHWA division office) the checklists and technical guidelines are provided to assist generalist engineers in (1) reviewing geotechnical reports and preliminary plan and specification packages; (2) recognizing cost-saving opportunities; (3) spotting deficiencies or potential claim problems due to inadequate geotechnical investigations, analysis, or design; (4) recognizing when to request technical assistance for a FHWA geotechnical specialist.

Third, it should be noted that the checklists and technical guidelines also include coverage of structure foundations. These review checklists and technical guidelines have been developed to fill an existing need in this area.

Fourth, this document sets forth minimum geotechnical standards or criteria to show transportation agencies and consultants the basic geotechnical information which FHWA recommends be provided in geotechnical reports and PS&E packages.

TABLE 1
PROJECT REVIEW GUIDELINES

The following project review guidelines are given to assist FHWA generalist engineers in determining what type and size projects may warrant review by a FHWA geotechnical specialist.

A FHWA geotechnical specialist should review Geotechnical reports and supporting data for major or unusual geotechnical features, described below. The FHWA division office should also request FHWA geotechnical specialist review for any project that is considered to involve geotechnical risk or excessive expense in its design or construction. Supporting data for these reviews include preliminary plans, specifications, and cost estimates (if available at the time of geotechnical report submittal). Emphasis will be placed on review of these projects in the preliminary stage in order to optimize cost savings through early identification of potential problems or more innovative designs. To be of maximum benefit geotechnical reports and supporting data should be forwarded for review as soon as available, and at least 60 days prior to the scheduled project advertisement date. The review by the FHWA geotechnical specialist should be completed within 10 working days.

A. “Major” Geotechnical Features

Geotechnical reports and supporting data for major geotechnical project features should be submitted to the FHWA geotechnical specialist for review if the following project cost and complexity criteria exist:

- | | <u>Cost Criteria</u> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| 1. Earthwork – soil or rock cuts or fills where (a) the maximum height of cut or fill exceeds 15 m (50 ft), or (b) the cuts or fills are located in topography and/or geological units with known stability problems. | Greater than \$1,000,000 |
| 2. Soil and Rock Instability Corrections – cut, fill, or natural slopes which are presently or potentially unstable. | Greater than \$ 500,000 |
| 3. Retaining Walls (geotechnical aspects) - maximum height at any point along the length exceeds 9 m (30 ft). Consideration of bidding cost-effective alternatives and geotechnical aspects (bearing capacity, settlement, overturning, sliding, etc.) are of prime concern. Structural design of and footings is beyond the scope of these reviews. | Greater than \$ 250,000 |

B. “Unusual” Geotechnical Features

Geotechnical reports and supporting data for all projects containing unusual geotechnical features should be submitted to the FHWA geotechnical specialist for review.

An unusual geotechnical project feature is any geotechnical feature involving: (1) difficult or unusual problems, e.g. embankment construction on a weak and compressible foundation material (difficult) or fills constructed using degradable shale (unusual); (2) new or complex designs, e.g. geotextile soil reinforcement, permanent ground anchors, wick drains, ground improvement technologies; and (3) questionable design methods, e.g. experimental retaining wall systems, pile foundations where dense soils exists.

What is a Geotechnical Report?

The geotechnical report is the tool used to communicate the site conditions and design and construction recommendations to the roadway design, bridge design, and construction personnel. Site investigations for transportation projects have the objective of providing specific information on subsurface soil, rock, and water conditions. Interpretation of the site investigation information, by a geotechnical engineer, results in design and construction recommendations that should be presented in a project geotechnical report. The importance of preparing an adequate geotechnical report cannot be overstressed. The information contained in this report is referred to often during the design period, construction period, and frequently after completion of the project (resolving claims). Therefore, the report should be as clear, concise, and accurate. Both an adequate site investigation and a comprehensive geotechnical report are necessary to construct a safe, cost-effective project. Engineers need these reports to conduct an adequate review of geotechnical related features, e.g., earthwork and foundations.

The State or their consultant should prepare “Preliminary” geotechnical reports for submittal to the design team whenever this information will benefit the design process. Early submittal of geotechnical information and recommendations or engineering evaluation of preliminary data may be necessary to establish basic design concepts or design criteria. This is commonly the case on large projects or projects containing complex or difficult geotechnical problems where alignment and/or grade changes may be appropriate based on geotechnical recommendations. The development of a “Final” geotechnical report will not normally be completed until design has progressed to the point where specific recommendations can be made for all of the geotechnical aspects of the work. Final alignment, grade, and geometry will usually have been selected prior to issuance of the final geotechnical report.

While the geotechnical report content and format will vary by project size and highway agency, all geotechnical reports should contain certain basic essential information, including:

- Summary of all subsurface exploration data, including subsurface soil profile, exploration logs, laboratory or in situ test results, and ground water information;
- Interpretation and analysis of the subsurface data;
- Specific engineering recommendations for design;
- Discussion of conditions for solution of anticipated problems; and
- Recommended geotechnical special provisions.

It is suggested that the State routinely include this minimum information in the geotechnical report for Federal-Aid highway projects and that a copy of this report be supplied to the FHWA division office at the time when the report is internally distributed in the State.

For brevity in this document, the term geotechnical report will be used as a general term to cover all types of geotechnical reports, e.g., foundation report, centerline soils report, landslide study report, etc.

Use of Review Checklists and Technical Guidelines

Review checklists have been prepared for review of geotechnical reports and review of the geotechnical aspects of preliminary plans, specification and estimate (PS&E)* packages. To simplify their use, the checklists are set up in a question and answer format. The geotechnical report checklists (pages 11 through 27) cover the important information that should be presented in project geotechnical reports. The PS&E review checklists (pages 28 through 33) cover the geotechnical aspects, ranging from assuring continuity between the project geotechnical report and contract documents to avoiding common claim pitfalls. Items that are identified with an asterisk (*) are considered to be of major importance. A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

Groups of related questions and, in some cases, individual questions have been cross referenced to the “Soils and Foundations Workshop Manual”** so as to provide the generalist engineer user a reference on basic geotechnical items. Technical guidelines are presented in Tables 1 through 4. Since it is not possible to establish strict criteria for all geotechnical information that should be obtained or geotechnical analysis that should be performed for a particular project, only general or minimum guidelines can be established. Table 1 provides definitions of both major and unusual features and guidelines as to which projects may be appropriate for review by the FHWA geotechnical specialist. Table 2 presents guideline minimum boring, sampling, and testing criteria for subsurface investigations that should be conducted for major or unusual geotechnical features. Table 3 presents general guidelines on the major types of geotechnical engineering analyses that are normally required for embankments and cut slopes, structure foundations, and retaining structures. Guidance is given for all major soil types. Table 4 presents a list of technical support data that should be provided for correction of soil and rock instabilities (landslides). Due to the unique situation that landslides present in terms of a major expenditure of funds for rehabilitation, a concise and specific list of necessary support information is warranted.

The enclosed review checklists and technical guidelines cover the following geotechnical features:

- Centerline Cuts and Embankments
- Embankments Over Soft Ground
- Landslide Corrections
- Retaining Structures
- Structure Foundations (spread footings, piles, drilled shafts)
- Ground Improvement Techniques
- Material Sites

*For the purposes of this document, PS&E refers to a plan and specification review at anytime during a project's development. Hence, the review may occur at a preliminary or partial stage of plan development.

** “Soils and Foundations Workshop Manual”, Publication # FHWA NHI-00-045

Reviews made during the preliminary stage of project development will commonly consist of reviewing the geotechnical report only, since detailed plans and specifications may not yet be prepared.

When reviewing the PS&E, the plans, special provisions, and final geotechnical report should be examined together. A major aspect of the PS&E review of project geotechnical features is to verify that the major design and construction recommendations given in the geotechnical report have been properly incorporated into the plans and specifications. The practice of most highway agencies is to prepare a single geotechnical report that includes subsurface information, interpretations, and design and construction recommendations. However, some agencies prepare two separate reports; one report that only presents the factual subsurface data (made available to bidders), and a separate report or design memorandum (not made available to bidders) which contains the interpretation of subsurface conditions and the design and construction recommendations. These reports not only form the basis of technical reviews but should also be the agency's basis for design and construction of earthwork and foundation features.

The review checklists should be used as the working document while the guidelines in Tables 1 through 4, and the indicated sections of the "Soils and Foundations Workshop Manual" should be used as references. The checklist questions should be completed by referring to the geotechnical report and contract documents, the appropriate sections of the tables, and by use of engineering judgement. For each question, the reviewer should indicate a yes, no, or unknown or non-application response. Upon completion of the checklists, the reviewer should summarize the negative responses and discuss these with the appropriate geotechnical engineers to determine if additional follow-up is appropriate.

Seismic design of geotechnical features has not been considered in this document. For guidance the reader is referred to "Geotechnical Engineering Circular No. 3, Design Guidance: Geotechnical Earthquake Engineering for Highways, Volume I – Design Principles", FHWA SA-97-076. Seismic loads represent an extreme loading condition therefore relatively low factors of safety are generally considered acceptable in a pseudo-static analysis. Factors of safety on the order of 1.1 to 1.15 are typically used in practice for both bearing capacity and sliding resistance. The choice of the factor of safety and of the seismic coefficient are intimately linked. For instance, of a seismic coefficient equal to the PGA (divided by g) has been used in the pseudo-static analysis because the foundation cannot tolerate large movements, a factor of safety of 1.0 may be used. Alternatively, if the seismic coefficient is one-half the PGA and the soil is susceptible to a post-peak strength decrease, a factor of safety of 1.1 to 1.15 should be used.

TABLE 2

GUIDELINE “MINIMUM” BORING, SAMPLING, AND TESTING CRITERIA

The most important step in geotechnical design is to conduct an adequate subsurface investigation. The number, depth, spacing and character of borings, sampling, and testing to be made in an individual exploration program are so dependent upon site conditions and the type of project and its requirements, that no “rigid” rules may be established. Usually the extent of work is established as the site investigation progresses in the field. However, the following are considered reasonable “guidelines” to follow to produce the minimum subsurface data needed to allow cost-effective geotechnical design and construction and to minimize claim problems. (Reference: “Subsurface Investigations” FHWA HI-97-021)

Geotechnical Feature		Minimum Number of Borings	Minimum Depth of Borings
Structure Foundation	1	per substructure unit under 30 m (100 ft) in width 2 per substructure unit over 30 m (100 ft) in width Additional borings in areas of erratic subsurface conditions	Spread footings: 2B where $L < 2B$, 4B where $L > 2B$ and interpolate for L between 2B and 4B Deep foundations: 6m (20ft) below tip elevation or two times maximum pile group dimension, whichever is greater If bedrock is encountered: for piles core 3 m (10 ft) below tip elevation; for shafts core 3D or 2 times maximum shaft group dimension below tip elevation, whichever is greater. Extend borings to depth of 0.75 to 1.5 times wall height When stratum indicates potential deep stability or settlement problem, extend borings to hard stratum
Retaining Structures	Borings	spaced every 30 to 60 m (100 to 200 ft). Some borings should be at the front of and some in back of the wall face.	
Bridge Approach Embankments over Soft Ground		When approach embankments are to be placed over soft ground, at least one boring should be made at each embankment to determine the problems associated with stability and settlement of the embankment. Typically, test borings taken for the approach embankments are located at the proposed abutment locations to serve a dual function.	Extend borings into competent material and to a depth where added stresses due to embankment load is less than 10% of existing effective overburden stress or 3 m (10 ft) into bedrock if encountered at a shallower depth Additional shallow explorations (hand auger holes) taken at approach embankment locations to determine depth and extent of unsuitable surface soils or topsoil.
Centerline Cuts and Embankments		Borings typically spaced every 60 m (200 ft) (erratic conditions) to 120 m (400 ft) (uniform conditions) with at least one boring taken in each separate landform. For high cuts and fills, should have a minimum of 3 borings along a line perpendicular to centerline or planned slope face to establish geologic cross-section for analysis.	Cuts: (1) in stable materials extend borings minimum 5 m (15 ft) below depth of cut at the ditch line and, (2) in weak soils extend borings below grade to firm materials or to twice the depth of cut whichever occurs first. Embankments: Extend borings to a hard stratum or to a depth of twice the embankment height.
Landslides	Minimum 3 borings	along a line perpendicular to centerline or planned slope face to establish geologic cross-section for analysis.	Extend borings to an elevation below active or potential failure surface and into hard stratum, or to a depth for which failure is unlikely because of geometry of cross-section. Slope inclinometers used to locate the depth of an active slide must extend below base of slide.
Ground Improvement Techniques		Varies widely depending in the ground improvement technique(s) being employed. For more information see “Ground Improvement Technical Summaries” FHWA SA-98-086R.	
Material Sites (Borrow sources, Quarries)		Borings spaced every 30 to 60 m (100 to 200 ft). Extend exploration to base of deposit or to depth required to provide needed quantity.	

TABLE 2 (Continued)

GUIDELINE “MINIMUM” BORING, SAMPLING, AND TESTING CRITERIA

<u>Sand or Gravel Soils</u>	SPT (split-spoon) samples should be taken at 1.5 m (5 ft) intervals or at significant changes in soil strata. Continuous SPT samples are recommended in the top 4.5 m (15 ft) of borings made at locations where spread footings may be placed in natural soils. SPT jar or bag samples should be sent to lab for classification testing and verification of field visual soil identification.
<u>Silt or Clay Soils</u>	SPT and “undisturbed” thin wall tube samples should be taken at 15 m (5 ft) intervals or at significant changes in strata. Take alternate SPT and tube samples in same boring or take tube samples in separate undisturbed boring. Tube samples should be sent to lab to allow consolidation testing (for settlement analysis) and strength testing (for slope stability and foundation bearing capacity Analysis). Field vane shear testing is also recommended to obtain in-place shear strength of soft clays, silts and well-rotted peat.
<u>Rock</u>	Continuous cores should be obtained in rock or shales using double or triple tube core barrels. In structural foundation investigations, core a minimum of 3 m (10 ft) into rock to insure it is bedrock and not a boulder. Core samples should be sent to the lab for possible strength testing (unconfined compression) if for foundation investigation. Percent core recovery and RQD value should be determined in field or lab for each core run and recorded on boring log.
<u>Groundwater</u>	Water level encountered during drilling, at completion of boring, and at 24 hours after completion of boring should be recorded on boring log. In low permeability soils such as silts and clays, a false indication of the water level may be obtained when water is used for drilling fluid and adequate time is not permitted after boring completion for the water level to stabilize (more than one week may be required). In such soils a plastic pipe water observation well should be installed to allow monitoring of the water level over a period of time. Seasonal fluctuations of water table should be determined where fluctuation will have significant impact on design or construction (e.g., borrow source, footing excavation, excavation at toe of landslide, etc.). Artesian pressure and seepage zones, if encountered, should also be noted on the boring log. In landslide investigations, slope inclinometer casings can also serve as water observations wells by using “leaky” couplings (either normal aluminum couplings or PVC couplings with small holes drilled through them) and pea gravel backfill. The top 0.3 m (1 ft) or so of the annular space between water observation well pipes and borehole wall should be backfilled with grout, bentonite, or sand-cement mixture to prevent surface water inflow which can cause erroneous groundwater level readings.
<u>Soil Borrow Sources</u>	Exploration equipment that will allow direct observation and sampling of the subsurface soil layers is most desirable for material site investigations. Such equipment that can consist of backhoes, dozers, or large diameter augers, is preferred for exploration above the water table. Below the water table, SPT borings can be used. SPT samples should be taken at 1.5 m (5 ft) intervals or at significant changes in strata. Samples should be sent to lab for classification testing to verify field visual identification. Groundwater level should be recorded. Observations wells should be installed to monitor water levels where significant seasonal fluctuation is anticipated.
<u>Quarry Sites</u>	Rock coring should be used to explore new quarry sites. Use of double or triple tube core barrels is recommended to maximize ore recovery. For riprap source, spacing of fractures should be carefully measured to allow assessment of rock sizes that can be produced by blasting. For aggregate source, the amount and type of joint infilling should be carefully noted. If assessment is made on the basis of an existing quarry site face, it may be necessary to core or use geophysical techniques to verify that nature of rock does not change behind the face or at depth. Core samples should be sent to lab for quality tests to determine suitability for riprap or aggregate.

TABLE 3

REQUIRED GEOTECHNICAL ENGINEERING ANALYSIS

Soil Classification Embankment and Cut		Slopes Structure Foundations		(Bridges and Retaining Structures)		Retaining Structures (Conventional, Crib and MSE)	
Unified AASHTO	¹ Soil Type Slope	Stability Analysis	² Settlement Analysis	Bearing Capacity Analysis	Settlement Analysis	Lateral Earth Pressure	Stability Analysis
GW	A-1-a	GRAVEL	Generally not required if cut or fill slope is 1.5H to 1V or flatter, and underdrains are used to draw down the water table in a cut slope.	Required for spread footings, pile or drilled shaft foundations.	Generally not needed except for SC soils or for large, heavy structures.	GW, SP, SW & SP soils generally suitable for backfill behind or in retaining or reinforced soil walls.	All walls should be designed to provide minimum F.S. = 2 against overturning & F.S. = 1.5 against sliding along base.
GP	A-1-a	Well-graded GRAVEL					
GM	A-1-b	Poorly-graded GRAVEL					
GC	A-2-6	Silty GRAVEL					
A-2-7		Clayey SAND					
SW	A-1-b	Well-graded SAND		Spread footings generally adequate except possibly for SC soils	Empirical correlations with SPT values usually used to estimate settlement		
SP	A-3	SAND	Erosion of slopes may be a problem for SW or SM soils.			GM, GC, SM & SC soils generally suitable if have less than 15% fines.	External slope stability considerations same as previously given for cut slopes & embankments.
SM	A-2-4	Poorly-graded SAND					
A-2-5		Silty SAND					
A-2-6		SAND					
A-2-7		Clayey					
ML A-4 SILT		Inorganic silt Sandy	Required unless non-plastic. Erosion of slopes may be a problem.	Required. Spread footing generally adequate.	Required. Can use SPT values if non-plastic.	These soils are not recommended for use directly behind or in retaining or reinforced soil walls.	
CL A-6 CLAY		Inorganic Lean Clay	Required Required				
OL A-4 SILT		Organic	Required Required				

¹ This is an approximate correlation to Unified (Unified Soil Classification system is preferred for geotechnical engineering usage, AASHTO system was developed for rating pavement subgrades).

² These are general guidelines, detailed slope stability analysis may not be required where past experience in area is similar or rock gives required slope angles.

TABLE 3 (Continued)

Soil Classification Embankment and Cut Slopes Structure Foundations				(Bridges and Retaining Structures)		Retaining Structures (Conventional, Crib and MSE)	
Unified AASHTO	¹ Soil Type	Slope Stability Analysis	² Settlement Analysis	Bearing Capacity Analysis	Settlement Analysis	Lateral Earth Pressure	Stability Analysis
MH A-5 SILT	Inorganic	Required. Erosion of slopes may be a problem.	Required.	Required. Deep foundation generally required unless soil has been preloaded.	Required. Consolidation test data needed to estimate settlement amount and time.	These soils are not recommended for use directly behind or in retaining walls.	All walls should be designed to provide minimum F.S. = 2 against overturning & F.S. = 1.5 against sliding along base.
CH A-7 CLAY	Inorganic Fat Clay	Required. Required.	Required.				
OH A-7 CLAY	Organic	Required. Required.	Required.	Deep foundation required unless peat excavated and replaced.	Highly compressible and not suitable for foundation support		External slope stability considerations same as previously given for cut slopes & embankments
PT ---- PEAT	Muck	Required. Required.	Long term settlement can be significant				
Rock	Fills – not required for slopes 1.5H to 1V or flatter. Cuts – required but depends on spacing, orientation and strength of discontinuities and durability of rock			Required for spread footings or drilled shafts. Empirically related to RQD ³	Required where rock is badly weathered or closely fractured (low RQD). May require in situ test such as pressuremeter.	Required. Use rock backfill angle of internal friction.	
REMARKS: Soils – temporary ground water control may be needed for foundation excavations in GW through SM soils. Backfill specifications for reinforced soil walls using metal reinforcements should meet the following requirements in insure use of non-corrosive backfill: pH range = 5 to 10; Resistivity > 3000 ohm-cm; Chlorides < 100 ppm; Sulfates < 200 ppm; Organic content 1% maximum Rock – Durability of shales (siltstone, claystone, mudstone, etc.) to be used in fills should be checked. Non-durable shales should be embanked as soils, i.e., placed in maximum 0.3 m (1 ft) loose lifts and compacted with heavy sheepfoot or grid rollers.							

¹ This is an approximate correlation to Unified (Unified Soil Classification system is preferred for geotechnical engineering usage, AASHTO system was developed for rating pavement subgrades).

² These are general guidelines, detailed slope stability analysis may not be required where past experience in area is similar or rock gives required slope angles.

³ RQD (Rock Quality Designation) = sum of pieces of rock core 4' or greater in length divided by the total length of core run.

TABLE 4
CORRECTION OF SOIL AND ROCK-RELATED INSTABILITIES

Each year hundreds of millions of dollars are spent to correct soil or rock-related instabilities on highways. The purpose of this technical note is to advise field engineers what technical support information is essential such that a complete evaluation can be performed. For the purpose of this technical note, soil and rock-related instabilities are defined as follows: “A condition that currently or threatens to affect the stability or performance the stability or performance of a highway facility and is the result of the inadequate performance of the soil or rock components.” This includes major instabilities resulting from or associated with: landslides, rockfalls, sinkholes, and degrading shales. Technical support data needed are:

1. Site plan and typical cross-section(s) representing ground surface conditions prior to failure, along with subsurface configuration after failure. Photographs, including aerials, if available, would also be beneficial.
2. Cross-section(s) showing soil and/or rock conditions and water bearing strata as determined by drilling and possibly geophysical surveys.
3. Description of the latent state of the unstable mass, whether movement has stopped or is still occurring, and if so, at what rate.
4. Boring logs.
5. Instrumentation data and/or other information used to define the depth and location of the failure zone. The underground location of the failure zone should be shown on the cross-section(s).
6. Shear strength test data and a description of the testing method utilized on the materials, through which failure is occurring. Where average shear strength is calculated using an assumed failure surface and a factor of safety of 1.0, the complete analysis should be provided and location of assumed water table(s) shown.
7. Proposed corrective schemes including: estimated costs, final safety factors, and design analysis for each alternative solution.
8. Narrative report containing instability history; record of maintenance costs and activity, and preventative measures taken, if any; reasons for inadequacy of the original design; description and results of subsurface investigation performed; summary and results of stability analysis performed; and recommendations for correction.

GEOTECHNICAL REPORT REVIEW CHECKLISTS

The following checklists cover the major information and recommendations that should be addressed in project geotechnical reports.

Section A covers site investigation information that will be common to all geotechnical reports for any type of geotechnical feature.

Sections B through I cover the basic information and recommendations that should be presented in geotechnical reports for specific geotechnical features: centerline cuts and embankments, embankments over soft ground, landslides, retaining structures, structure foundations and material sites.

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In most sections and subsections the user has been provided supplemental page references to the “Soils and Foundations Workshop Manual” FHWA NHI-00-045. These page numbers appear in parentheses () immediately adjacent to the section or subsection topic. Generalist engineers are particularly encouraged to read these references. Additional reference information on these topics is available in the Geotechnical Engineering Notebook, a copy of which is kept in all FHWA Division offices by either the Bridge Engineer or the engineer with the geotechnical collateral duty.

Certain checklist items are of vital importance to have been included in the geotechnical report. These checklist items have been marked with an asterisk (*). A negative response to any of these asterisked items is cause to contact the geotechnical engineer for clarification of this omission.

GTR REVIEW CHECKLIST FOR SITE INVESTIGATION

A. Site Investigation Information

Since the most important step in the geotechnical design process is to conduct an adequate site investigation, presentation of the subsurface information in the geotechnical report and on the plans deserves careful attention.

<u>Geotechnical Report Text</u> (Introduction) (Pgs. 10-1 to 10-4)	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
1. Is the general location of the investigation described and/or a vicinity map included?	_____	_____	_____
2. Is scope and purpose of the investigation summarized?	_____	_____	_____
3. Is concise description given of geologic setting and topography of area?	_____	_____	_____
4. Are the field explorations and laboratory tests on which the report is based listed?	_____	_____	_____
5. Is the general description of subsurface soil, rock, and groundwater conditions given?	_____	_____	_____
*6. Is the following information included with the geotechnical report (typically included in the report appendices):			
a. Test hole logs? (Pgs. 2-24 to 2-32)	_____	_____	_____
b. Field test data?	_____	_____	_____
c. Laboratory test data? (Pgs. 4-22 to 4-23)	_____	_____	_____
d. Photographs (if pertinent)?	_____	_____	_____
<u>Plan and Subsurface Profile</u> (Pgs. 2-19, 3-9 to 3-12, 10-13)			
*7. Is a plan and subsurface profile of the investigation site provided?	_____	_____	_____
8. Are the field explorations located on the plan view?	_____	_____	_____

*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

A. <u>Site Investigation Information</u> (Cont.)	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
*9. Does the conducted site investigation meet minimum criteria outlined in Table 2?	_____	_____	_____
10. Are the explorations plotted and correctly numbered on the profile at their true elevation and location?	_____	_____	_____
11. Does the subsurface profile contain a word description and/or graphic depiction of soil and rock types?	_____	_____	_____
12. Are groundwater levels and date measured shown on the subsurface profile?	_____	_____	_____
<u>Subsurface Profile or Field Boring Log</u> (Pgs. 2-14, 2-15, 2-24 to 2-31)			
13. Are sample types and depths recorded?	_____	_____	_____
*14. Are SPT blow count, percent core recovery, and RQD values shown?	_____	_____	_____
15. If cone penetration tests were made, are plots of cone resistance and friction ratio shown with depth?	_____	_____	_____
<u>Laboratory Test Data</u> (Pgs. 4-6, 4-22, 4-23)			
*16. Were lab soil classification tests such as natural moisture content, gradation, Atterberg limits, performed on selected representative samples to verify field visual soil identification?	_____	_____	_____
17. Are laboratory test results such as shear strength (Pg. 4-14), consolidation (Pg. 4-9), etc., included and/or summarized?	_____	_____	_____

*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

GTR REVIEW CHECKLIST FOR CENTERLINE CUTS AND EMBANKMENTS

B. Centerline Cuts and Embankments (Pgs. 2-2 to 2-6)

In addition to the basic information listed in Section A, is the following information provided in the project geotechnical report.

Are station-to-station descriptions included for:	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
1. Existing surface and subsurface drainage?	_____	_____	_____
2. Evidence of springs and excessively wet areas?	_____	_____	_____
3. Slides, slumps, and faults noted along the alignment?	_____	_____	_____

Are station-to-station recommendations included for the following?

General Soil Cut or Fill

4. Specific surface/subsurface drainage recommendations?	_____	_____	_____
5. Excavation limits of unsuitable materials?	_____	_____	_____
*6. Erosion protection measures for back slopes, side slopes, and ditches, including riprap recommendations or special slope treatment.	_____	_____	_____

Soil Cuts (Pgs. 5-23, 5-24)

*7. Recommended cut slope design?	_____	_____	_____
8. Are clay cut slopes designed for minimum F.S. = 1.50?	_____	_____	_____
9. Special usage of excavated soils?	_____	_____	_____
10. Estimated shrink-swell factors for excavated materials?	_____	_____	_____
11. If answer to 3 is yes, are recommendations provided for design treatment?	_____	_____	_____

*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

B. <u>Centerline Cuts and Embankments</u> (Cont.)	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
<u>Fills</u> (Pgs. 5-1 to 5-3)			
12. Recommended fill slope design?	_____	_____	_____
13. Will fill slope design provide minimum F.S. = 1.25?	_____	_____	_____
<u>Rock Slopes</u>			
*14. Are recommended slope designs and blasting specifications provided?	_____	_____	_____
*15. Is the need for special rock slope stabilization measures, e.g., rockfall catch ditch, wire mesh slope protection, shotcrete, rock bolts, addressed?	_____	_____	_____
16. Has the use of “template” designs been avoided (such as designing all rock slopes on 0.25:1 rather than designing based on orientation of major rock jointing)?	_____	_____	_____
*17. Have effects of blast induced vibrations on adjacent structures been evaluated?	_____	_____	_____

*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

GTR REVIEW CHECKLIST FOR EMBANKMENTS OVER SOFT GROUND

C. Embankments Over Soft Ground

Where embankments must be built over soft ground (such as soft clays, organic silts, or peat), stability and settlement of the fill should be carefully evaluated. In addition to the basic information listed in Section A, is the following information provided in the project geotechnical report?

<u>Embankment Stability</u> (Pgs. 5-1 to 5-3, 5-20 to 5-22)	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
*1. Has the stability of the embankment been evaluated for minimum F.S. = 1.25 for side slope and 1.30 for end slope of bridge approach embankments?	_____	_____	_____
*2. Has the shear strength of the foundation soil been determined from lab testing and/or field vane shear or cone penetrometer tests?	_____	_____	_____
*3. If the proposed embankment does not provide minimum factors of safety given above, are recommendations given or feasible treatment alternates, which will increase factor of safety to minimum acceptable (such as change alignment, lower grade, use stabilizing counterberms, excavate and replace weak subsoil, lightweight fill, geotextile fabric reinforcement, etc.)?	_____	_____	_____
*4. Are cost comparisons of treatment alternates given and a specific alternate recommended?	_____	_____	_____
<u>Settlement of Subsoil</u> (Pgs. 6-7 to 6-20)			
5. Have consolidation properties of fine-grained soils been determined from laboratory consolidation tests?	_____	_____	_____
*6. Have settlement amount and time been estimated?	_____	_____	_____
7. For bridge approach embankments, are recommendations made to get the settlement out before the bridge abutment is constructed (waiting period, surcharge, or wick drains)?	_____	_____	_____

*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

C. <u>Embankments Over Soft Ground</u> (Cont.)	<u>Yes</u>	<u>No</u>	Unknown or N/A
8. If geotechnical instrumentation is proposed to monitor fill stability and settlement, are detailed recommendations provided on the number, type, and specific locations of the proposed instruments?	_____	_____	_____
<u>Construction Considerations</u> (Pgs. 10-8, 10-9)			
9. If excavation and replacement of unsuitable shallow surface deposits (peat, muck, top soil) is recommended, are vertical and lateral limits of recommended excavation provided?	_____	_____	_____
10. Where a surcharge treatment is recommended, are plan and cross-section of surcharge treatment provided in geotechnical report for benefit of the roadway designer?	_____	_____	_____
11. Are instructions or specifications provided concerning instrumentation, fill placement rates and estimated delay times for the contractor?	_____	_____	_____
12. Are recommendations provided for disposal of surcharge material after the settlement period is complete?	_____	_____	_____

*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

GTR REVIEW CHECKLIST FOR LANDSLIDE CORRECTIONS

D. Landslide Corrections (Pgs. 5-1 to 5-4, 5-17 to 5-20)

In addition to the basic information listed in Section A, is the following information provided in the landslide study geotechnical report? (Refer to Table 4 for guidance on the necessary technical support data for correction of slope instabilities.)

	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
*1. Is a site plan and scaled cross-section provided showing ground surface conditions both before and after failure?	_____	_____	_____
*2. Is the past history of the slide area summarized, including movement history, summary of maintenance work and costs, and previous corrective measures taken, if any?	_____	_____	_____
*3. Is a summary given of results of site investigation, field and lab testing, and stability analysis, including cause(s) of the slide?	_____	_____	_____

Plan

4. Are detailed slide features, including location of ground surface cracks, head scarp, and toe bulge, shown on the site plan?	_____	_____	_____
---------------------------------------------------------------------------------------------------------------------------------	-------	-------	-------

Cross-section

*5. Are the cross-sections used for stability analysis included with the soil profile, water table, soil unit weights, soil shear strengths, and failure plane shown as it exists?	_____	_____	_____
6. Is slide failure plane location determined from slope indicators?	_____	_____	_____
*7. For an active slide, was soil strength along the slide failure plane back-calculated using a F.S. = 1.0 at the time of failure?	_____	_____	_____

*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

D. <u>Landslide Corrections</u> (Cont.)	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
-----------------------------------------	------------	-----------	---------------------------

Text

- *8. Is the following information presented for each proposed correction alternative (typical correction methods include buttress, shear key, rebuild slope, surface drainage, subsurface drainage-interceptor, drain trenches or horizontal drains, etc.).
- | | | | |
|-------------------------------------------|-------|-------|-------|
| a. Cross-section of proposed alternative? | _____ | _____ | _____ |
| b. Estimated safety factor? | _____ | _____ | _____ |
| c. Estimated cost? | _____ | _____ | _____ |
| c. Advantages and disadvantages? | _____ | _____ | _____ |
9. Is recommended correction alternative(s) given that provide a minimum F.S. = 1.25? _____
10. If horizontal drains are proposed as part of slide correction, has subsurface investigation located definite water bearing strata that can be tapped with horizontal drains? _____
11. If a toe counter berm is proposed to stabilize an active slide has field investigation confirmed that the toe of the existing slide does not extend beyond the toe of the proposed counter berm? _____

Construction considerations

- | | | | |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------|-------|
| 12. Where proposed correction will require excavation into the toe of an active slide (such as for buttress or shear key) has the “during construction backslope F.S.” with open excavation been determined? | _____ | _____ | _____ |
| 13. If open excavation F.S. is near 1.0, has excavation stage stage construction been proposed? | _____ | _____ | _____ |
| 14. Has seasonal fluctuations of groundwater table been considered? | _____ | _____ | _____ |
| 15. Is stability of excavation backslope to be monitored? | _____ | _____ | _____ |
| 16. Are special construction features, techniques and materials described and specified? | _____ | _____ | _____ |

*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

GTR REVIEW CHECKLIST FOR RETAINING STRUCTURES

E. Retaining Structures (See “Earth Retaining Structures” FHWA NHI-99-025)

In addition to the basic information listed in Section A, is the following information provided in the project geotechnical report?

	Yes	No	Unknown or N/A
*1. Recommended soil strength parameters and groundwater elevations for use in computing wall design lateral earth pressures and factor of safety for overturning, sliding, and external slope stability.	_____	_____	_____
2. Is it proposed to bid alternate wall designs?	_____	_____	_____
*3. Are acceptable reasons given for the choice and/or exclusion of certain wall types?	_____	_____	_____
*4. Is an analysis of the wall stability included with minimum acceptable factors of safety against overturning (F.S. = 2.0), sliding (F.S. = 1.5), and external slope stability (F.S. = 1.5)?	_____	_____	_____
5. If wall will be placed on compressible foundation soils, is estimated total, differential and time rate of settlement given?	_____	_____	_____
6. Will wall types selected for compressible foundation soils allow differential movement without distress?	_____	_____	_____
7. Are wall drainage details, including materials and compaction, provided?	_____	_____	_____

Construction Considerations

8. Are excavation requirements covered including safe slopes for open excavations or need for sheeting or shoring?	_____	_____	_____
9. Fluctuation of groundwater table?	_____	_____	_____

*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

Top-down Construction Type Walls (See “Manual for Design & Construction Monitoring of Soil Nail Walls”, FHWA SA-96-069R and “Ground Anchors and Anchored Systems”, FHWA IF-99-015)

	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
*10. For soil nail and anchor walls are the following included in the geotechnical report?			
a. Design soil parameters (ϕ , c , γ)	___	___	___
b. Minimum bore size (soil nails)?	___	___	___
c. Design pullout resistance (soil nails)?	___	___	___
d. Ultimate anchor capacity (anchors)?	___	___	___
e. Corrosion protection requirements?	___	___	___

*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

GTR REVIEW CHECKLIST FOR SPREAD FOOTINGS

F. Structure Foundations – Spread Footings (Pgs. 7-1 to 7-17)

In addition to the basic information listed in Section A, is the following information provided in the project foundation report?

	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
*1. Are spread footing recommended for foundation support? If not, are reasons for not using them discussed?	_____	_____	_____
If spread footing supports are recommended, are conclusions and recommendations given for the following:			
*2. Is recommended bottom of footing elevation and reason for recommendation (e.g., based on frost depth, estimated scour depth, or depth to competent bearing material) given?	_____	_____	_____
*3. Is recommended allowable soil or rock bearing pressure given?	_____	_____	_____
*4. Is estimated footing settlement and time given?	_____	_____	_____
*5. Where spread footings are recommended to support abutments placed in the bridge end fill, are special gradation and compaction requirements provided for select end fill and backwall drainage material (Pgs. 6-1 to 6-4)	_____	_____	_____

Construction Considerations

6. Have the materials been adequately described on which the footing is to be placed so the project inspector can verify that material is as expected?	_____	_____	_____
7. Have excavation requirements been included for safe slopes in open excavations, need for sheeting or shoring, etc.?	_____	_____	_____
8. Has fluctuation of the groundwater table been addressed?	_____	_____	_____

*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

GTR REVIEW CHECKLIST FOR DRIVEN PILES

G. Structure Foundations – Driven Piles (Pgs. 8-1 to 8-29, 9-1 to 9-35)

In addition to the basic information listed in Section A, if pile support is recommended or given as an alternative, conclusions/recommendations should be provided in the project geotechnical report for the following:

	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
*1. Is the recommended pile type given (displacement, non-displacement, steel pipe, concrete, H-pile, etc.) with valid reasons given for choice and/or exclusion? (Pgs. 8-1 to 8-3)	_____	_____	_____
2. Do you consider the recommended pile type(s) to be the most suitable and economical?	_____	_____	_____
*3. Are estimated pile lengths and estimated tip elevations given for the recommended allowable pile design loads?	_____	_____	_____
4. Do you consider the recommended design loads to be reasonable?	_____	_____	_____
5. Has pile group settlement been estimated (only of practical significance for friction pile groups ending in cohesive soil)? (Pgs. 8-20 to 8-22)	_____	_____	_____
6. If a specified or minimum pile tip elevation is recommended, is a clear reason given for the required tip elevation, such as underlying soft layers, scour, downdrag, piles uneconomically long, etc.?	_____	_____	_____
*7. Has design analysis (wave equation analysis) verified that the recommended pile section can be driven to the estimated or specified tip elevation without damage (especially applicable where dense gravel-cobble-boulder layers or other obstructions have to be penetrated)?	_____	_____	_____
8. Where scour piles are required, have pile design and driving criteria been established based on mobilizing the full pile design capacity below the scour zone?	_____	_____	_____

*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

G. <u>Structure Foundations – Driven Piles (Cont.)</u>	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
9. Where lateral load capacity of large diameter piles is an important design consideration, are p-y curves (load vs. deflection) or soil parameters given in the geotechnical report to allow the structural engineer to evaluate lateral load capacity of all piles?	_____	_____	_____
*10. For pile supported bridge abutments over soft ground:			
a. Has abutment downdrag load been estimated and solutions such bitumen coating been considered in design? Not generally required if surcharging of the fill is being performed. (Pgs. 8-21, 8-23)	_____	_____	_____
b. Is bridge approach slab recommended to moderate differential settlement between bridge ends and fill?	_____	_____	_____
c. If the majority of subsoil settlement will not be removed prior to abutment construction (by surcharging), has estimate been made of abutment rotation that can occur due to lateral squeeze of soil subsoil? (Pgs. 5-25, 5-26)	_____	_____	_____
d. Does the geotechnical report specifically alert the structural designer to the estimated horizontal abutment movement?	_____	_____	_____
11. If bridge project is large, has pile load test program been recommended? (Pgs. 9-23 to 9-26)	_____	_____	_____
12. For major structure in high seismic risk area, has assessment been made of liquefaction potential of foundation soil during design earthquake (only loose saturated sands and silts are susceptible to liquefaction)? (See GEC No. 3, FHWA SA-97-076)	_____	_____	_____

*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

G. Structure Foundations – Driven Piles (Cont.)

<u>Construction Considerations</u> (Pgs. 9-4 to 9-35)	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
13. Pile driving details such as: boulders or obstructions which may be encountered during driving; need for preaugering, jetting, spudding; need for pile tip reinforcement; driving shoes, etc.?	_____	_____	_____
14. Excavation requirements: safe slope for open excavations; need for sheeting or shoring; fluctuation of groundwater table?	_____	_____	_____
15. Have effects of pile driving operation on adjacent structures been evaluated such as protection against damage caused by footing excavation or pile driving vibrations?	_____	_____	_____
16. Is preconstruction condition survey to be made of adjacent structures to prevent unwarranted damage claims?	_____	_____	_____
17. On large pile driving projects, have other methods of pile driving control been considered such as dynamic testing or wave equation analysis?	_____	_____	_____

*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

GTR REVIEW CHECKLIST FOR DRILLED SHAFTS

H. Structure Foundations – Drilled Shafts (Pgs. 8-23 to 8-29)

In addition to the basic information listed in Section A, if drilled shaft support is recommended or given as an alternative, are conclusion/recommendations provided in the project foundation report for the following:

	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
*1. Are recommended shaft diameter(s) and length(s) for allowable design loads based on an analysis using soil parameters for side friction and end bearing?	_____	_____	_____
*2. Settlement estimated for recommended design loads?	_____	_____	_____
*3. Where lateral load capacity of shaft is an important design consideration, are p-y (load vs. deflection) curves or soils data provided in geotechnical report that will allow structural engineer to evaluate lateral load capacity of shaft?	_____	_____	_____
4. Is static load test (to plunging failure) recommended?	_____	_____	_____
<u>Construction Considerations</u>			
5. Have construction methods been evaluated, i.e., can less expensive dry method or slurry method be used or will casing be required?	_____	_____	_____
6. If casing will be required, can casing be pulled as shaft is concreted (this can result in significant cost savings on very large diameter shafts)?	_____	_____	_____
7. If artesian water was encountered in explorations, have design provisions been included to handle it (such as by requiring casing and a tremie seal)?	_____	_____	_____
8. Will boulders be encountered? (If boulders will be encountered, then the use of shafts should be seriously questioned due to construction installation difficulties and resultant higher cost to boulders can cause.)	_____	_____	_____

*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

GTR REVIEW FOR GROUND IMPROVEMENT TECHNIQUES

I. Ground Improvement Techniques

In addition to the basic information listed in Section A, if ground improvement techniques are recommended or given as an alternative, are conclusion/recommendations provided in the project foundation report for the following:

	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
1. For wick drains, do recommendations include the coefficient of consolidation for horizontal drainage, c_h , and the length and spacing of wick drains?	_____	_____	_____
2. For lightweight fill, do recommendations include the material properties (ϕ , c , γ), permeability, compressibility, and drainage requirements?	_____	_____	_____
3. For vibro-compaction, do the recommendations include required degree of densification (e.g., relative density, SPT blow count, etc.), settlement limitations, and quality control?	_____	_____	_____
4. For dynamic compaction, do the recommendations include required degree of densification (e.g., relative density, SPT blow count, etc.), settlement limitations, and quality control?	_____	_____	_____
5. For stone columns, do the recommendations include spacing and dimensions of columns, bearing capacity, settlement characteristics, and permeability (seismic applications)?	_____	_____	_____
6. For grouting, do the recommendations include the grouting method (permeation, compaction, etc.), material improvement criteria, settlement limitations, and quality control?	_____	_____	_____

*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

GTR REVIEW CHECKLIST FOR MATERIAL SITES

J. Material Sites

In addition to the basic information listed in Section A, is the following information provided in the project Material Site Report.

	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
1. Material site location, including description of existing or proposed access routes and bridge load limits, if any?	___	___	___
*2. Have soil samples representative of all materials encountered during pit investigation been submitted and tested?	___	___	___
*3. Are laboratory quality test results included in the report?	___	___	___
4. For aggregate sources, do the laboratory quality test results (such as L.A. abrasion, sodium sulfate, degradation, absorption, reactive aggregate, etc.) indicate if specification materials can be obtained from the deposit using normal processing methods?	___	___	___
5. If the lab quality test results indicate that specification material cannot be obtained from the pit materials as they exist naturally, has the source been rejected or are detailed recommendations provided for processing or controlling production so as to ensure a satisfactory product?	___	___	___
*6. For soil borrow sources, have possible difficulties been noted, such as above optimum moisture content for clay-silt soils, waste due to high PI, boulders, etc.?	___	___	___
*7. Where high moisture content clay-silt soils must be used, are recommendations provided on the need for aeration to allow the materials to dry out sufficiently to meet compaction requirements?	___	___	___
8. Are estimated shrink-swell factors provided.	___	___	___

*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

I. <u>Material Sites</u> (Cont.)	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
*9. Do the proven material site quantities satisfy the estimated project quantity needs?	_____	_____	_____
10. Where materials will be executed from below the water table, have seasonal fluctuations of the water table been determined?	_____	_____	_____
11. Are special permit requirements been covered?	_____	_____	_____
12. Have pit reclamation requirements been covered adequately?	_____	_____	_____
13. Has a material site sketch (plan and profile) been provided for inclusion in the plans, which contains:	_____	_____	_____
a. Material site number?	_____	_____	_____
b. North arrow and legal subdivision?	_____	_____	_____
c. Test hole or test pit logs, locations, numbers and date?	_____	_____	_____
d. Water table elevation and date?	_____	_____	_____
e. Depth of unsuitable overburden, which will have to be stripped?	_____	_____	_____
f. Suggested overburden disposal area?	_____	_____	_____
g. Proposed mining area and previously mined areas?	_____	_____	_____
h. Existing stockpile locations?	_____	_____	_____
i. Existing or suggested access road?	_____	_____	_____
j. Bridge load limits?	_____	_____	_____
k. Reclamation details?	_____	_____	_____
14. Are recommended special provisions provided?	_____	_____	_____

*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

PS&E REVIEW CHECKLISTS

Plans and specifications (PS&E)** reviews of projects with major or unusual geotechnical features¹ should preferably be made by examining the plans, special provisions, and geotechnical report together.***

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Certain checklist items are of vital importance to have been included in the PS&E. These checklist items have been marked with an asterisk (*). A negative response to any of these asterisked items is cause to contact the geotechnical engineer for clarification of this omission.

The information covered in Section A, General will apply to all geotechnical features. The rest of the sections cover additional important PS&E review items that pertain to specific geotechnical features.

** For purposes of this document, PS&E refers to a plan and specification review at any time during a project's development. Hence, the review may be at a preliminary or partial stage of plan development.

***When plan reviews are conducted at a partial stage the final geotechnical report may not be available.

¹Major and unusual geotechnical features are defined in Table 1.

PS&E REVIEW CHECKLIST – GENERAL

A. <u>General</u>	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
*1. Has the appropriate geotechnical engineer reviewed the PS&E to ensure that the design and construction recommendations have been incorporated as intended and that the subsurface information has been presented correctly? <u>This is absolutely necessary.</u>	_____	_____	_____
2. Are the finished profile exploration logs and locations included in the plans?	_____	_____	_____
*3. Have geotechnical designs prepared by region or district offices or consultants been reviewed and approved by the State Headquarters' geotechnical engineer?	_____	_____	_____
4. Do the contract documents contain the special provisions as provided in the project geotechnical report?	_____	_____	_____
5. Have the following common pitfalls been avoided:			
a. Has an adequate site investigation been conducted (reasonably meeting or exceeding the minimum criteria given in Table 2)?	_____	_____	_____
b. Has the use of "subjective" subsurface terminology (such as relatively soft rock or gravel with occasional boulders) been avoided?	_____	_____	_____
c. If alignment has been shifted, have additional subsurface explorations been conducted along the new alignment?	_____	_____	_____
d. Has a note been included in the contract indicating all subsurface information is available to bidders?	_____	_____	_____
e. Do you think the wording of the geotechnical special provisions are clear, specific and unambiguous?	_____	_____	_____

*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

PS&E REVIEW CHECKLIST FOR SPECIFIC FEATURES

B. <u>Centerline Cuts and Embankments</u>	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
1. Where excavation is required, are excavation limits and description of unsuitable organic soils shown on the plans?	_____	_____	_____
2. Are plan details and special provisions provided for special drainage details, such as lined surface ditches, drainage blanket under sidehill fill, interceptor trench drains, etc.?	_____	_____	_____
3. Are special provisions included for fill materials requiring special treatment, such as nondurable shales, lightweight fill, etc.?	_____	_____	_____
4. Are special provisions provided for any special rock slope excavation and stabilization measures called for in plans, such as controlled blasting, wire mesh slope protection, rock bolts, shotcrete, etc.?	_____	_____	_____
C. <u>Embankments Over Soft Ground</u>			
*1. Where subexcavation is required, are excavation limits and description of unsuitable soils clearly shown on the plans?	_____	_____	_____
*2. Where settlement waiting period will be required, has estimated settlement time been stated in the special provisions to allow bidders to fairly bid the project?	_____	_____	_____
*3. If instrumentation will be used to control the rate of fill placement, do special provisions clearly spell out how this will be done and how the readings will be used to control the contractor's operation?	_____	_____	_____
4. Do special provisions state that any instrumentation damage by contractor personnel will be repaired at the contractor's expense?	_____	_____	_____

*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

PS&E REVIEW CHECKLIST FOR SPECIFIC FEATURES

D. <u>Landslide Corrections</u>	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
1. Are plan details and special provisions provided for special drainage details, such as lined surface ditches, drainage blankets, horizontal drains, etc.?	_____	_____	_____
*2. Where excavation is to be made into the toe of an active slide, such as for a buttress or shear key, and stage construction is required, do the special provisions clearly spell out the stage construction sequence to be followed?	_____	_____	_____
*3. Where a toe buttress is to be constructed, do the special provisions clearly state gradation and compaction requirements for the buttress material?	_____	_____	_____
*4. If the geotechnical report recommends that slide repair work not be allowed during the wet time of the year, is the proposed construction schedule in accord with this?	_____	_____	_____
E. <u>Retaining Structures</u>			
*1. Are select materials specified for wall backfill with gradation and compaction requirements covered in the specification?	_____	_____	_____
2. Are limits of required select backfill zones clearly detailed on the plans?	_____	_____	_____
3. Are excavation requirements specified, e.g., safe slopes for excavations, need for sheeting, etc.?	_____	_____	_____
*4. Where alternative wall types will be allowed, are fully detailed plans included for all alternatives?	_____	_____	_____
5. Were designs prepared by the wall supplier?	_____	_____	_____
6. Were wall supplier's design calculations and specifications reviewed and approved by the structural and geotechnical engineers?	_____	_____	_____

*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

PS&E REVIEW CHECKLIST FOR SPECIFIC FEATURES

E. <u>Retaining Structures</u> (Cont.)	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
*7. Where proprietary retaining walls are bid as alternates, does bid schedule require bidders to designate which alternate their bid is for, to prevent bid shopping after contract award?	_____	_____	_____
8. Have FHWA guidelines for experimental designations for certain proprietary wall types been followed?	_____	_____	_____
9. Is ROW limit or easements shown on plans and mentioned in specifications where anchors are to be installed?	_____	_____	_____
<u>Top-down Construction Type Walls</u> (See “Manual for Design & Construction Monitoring of Soil Nail Walls”, FHWA SA-96-069R and “Ground Anchors and Anchored Systems”, FHWA IF-99-015)			
*10. For soil nail and anchor walls are the following included in the provisions:			
a. Construction tolerances?	_____	_____	_____
b. Minimum drill-hole size?	_____	_____	_____
c. Material requirements?	_____	_____	_____
d. Load testing procedures and acceptance criteria?	_____	_____	_____
e. Construction monitoring requirements?	_____	_____	_____

*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

PS&E REVIEW CHECKLIST FOR SPECIFIC FEATURES

F. <u>Structure Foundations – Spread Footings</u>	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
*1. Where spread footings are to be placed on natural soil, is the specific bearing strata in which the footing is to be founded clearly described, e.g., placed on Br. Sandy GRAVEL deposit, etc.?	_____	_____	_____
*2. Where spread footings are to be placed in the bridge end fill, are gradation and compaction requirements, for the select fill and backfill drainage material, covered in the special provisions, standard specifications, or standard structure sheets?	_____	_____	_____
 G. <u>Structure Foundations – Driven Piles</u>			
1. Do plan details adequately cover pile splices tip reinforcement, driving shoes, etc.?	_____	_____	_____
*2. Where friction piles are to be driven in silty or clayey soils, significant setup or soil freeze affecting long-term capacity may occur. Do specifications require retapping the piles after 24 to 48 hour waiting period when required bearing is not obtained at estimated length at the end of initial driving?	_____	_____	_____
3. Where friction piles are to be load tested, has a reaction load of four times design load been specified to allow load testing the pile to plunging failure so that the ultimate soil capacity can be determined?	_____	_____	_____
4. Where end bearing steel piles are to be load tested, has load test been designed to determine if higher than 62 MPa (9 ksi) allowable steel stress can be used, e.g., 83 to 103 MPa (12 – 15 ksi)?	_____	_____	_____
*5. Where cofferdam construction will be required, have soil gradation results been included in the plans or been made available to bidders to assist them in determining dewatering procedures?	_____	_____	_____

*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

PS&E REVIEW CHECKLIST FOR SPECIFIC FEATURES

G. <u>Structure Foundations – Driven Piles (Cont.)</u>	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
*6. If a wave equation analysis will be used to approve the contractor's pile driving hammer, has a minimum hammer energy or estimated soil resistance in kN (tons) to be overcome to drive the piles to the estimated length, been given in the special provisions?	_____	_____	_____
*7. Has the appropriate safety factor, based on construction control method (static load test, dynamic load test, wave equation, etc.) been included? Have the specifications for the applicable construction control method been included?	_____	_____	_____
H. <u>Structure Foundations – Drilled Shafts</u>			
*1. Where drilled shafts are to be placed in soil, is the specified bearing stratum in which the drilled shaft is to be found clearly described, e.g., placed on Br. Sandy GRAVEL deposit, etc.?	_____	_____	_____
2. Where end bearing drilled shafts are to be founded on rock, has the rock elevation at the shaft pier locations been determined from borings at the pier locations?	_____	_____	_____
3. Where drilled shafts are to be socketed some depth into rock, have rock cores been extracted at depths to 3 m (10 ft) below proposed socket at location within 3 m (10 ft) of the shaft?	_____	_____	_____
*4. Are shafts equipped with PVC access tubes to accommodate non-destructive testing (gamma/gamma logging, cross-hole sonic logging) of the shaft? Are provisions for the appropriate non-destructive testing methods included?	_____	_____	_____

*A response other than (yes) or (N/A) for any of these checklist questions is cause to contact the appropriate geotechnical engineer for a clarification and/or to discuss the project.

PS&E REVIEW CHECKLIST FOR SPECIFIC FEATURES

I. <u>Ground Improvement Techniques</u>	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
1. For wick drains, are contractor submittals required that include proposed equipment and materials, method(s) for addressing obstructions, and method(s) for splicing wick drains.	_____	_____	_____
2. For lightweight fill, are minimum/maximum densities, gradation, lift thickness, and method of compaction specified?	_____	_____	_____
3. For vibro-compaction, are contractor submittals required that include proposed equipment and materials? Are methods of measurement and acceptance criteria specified?	_____	_____	_____
4. For dynamic compaction:			
a. If method specification is used, are the following specified: tamper mass and size; drop height, grid spacing; applied energy; number of phases or passes; site preparation requirements; subsequent surface compaction procedures?	_____	_____	_____
b. If performance specification is used, are the following specified: minimum soil property value to be achieved and method of measurement; maximum permissible settlement?	_____	_____	_____
5. For stone columns, are the following specified: site preparation, backfill materials, minimum equipment requirements, acceptance criteria and quality assurance procedures?	_____	_____	_____
6. For grouting, are contractor submittals required that include proposed equipment and materials. Are methods of measurement and acceptance criteria specified?	_____	_____	_____

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PS&E REVIEW CHECKLIST FOR SPECIFIC FEATURES

J. <u>Material Sites</u>	<u>Yes</u>	<u>No</u>	<u>Unknown or N/A</u>
*1. Is a material site sketch, containing the basic information listed on page 27, included in the plans?	_____	_____	_____
*2. Has the material site investigation established a proven quantity of material sufficient to satisfy the project estimated quantity needs?	_____	_____	_____
3. Where specification material cannot be obtained directly from the natural deposit, do the special provisions clearly spell out that processing will be required?	_____	_____	_____
4. Are contractor special permit requirements covered in the special provisions?	_____	_____	_____
5. Are pit reclamation requirements clearly spelled out on the plans and in the special provisions?	_____	_____	_____

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KENTUCKY TRANSPORTATION CABINET
Division of Materials
Geotechnical Branch

SUMMARY OF COST ITEMS FOR STATEWIDE GEOTECHNICAL ENGINEERING SERVICES

County	ITEM #	MARS #		
ROAD NAME	CONTRACT #	ESTIMATE #		
	Hourly Rate	Units/Hours	No. of Test/Samples	TOTAL
1. Moisture Content Test	\$ <u> </u>	x <u> </u>	x <u> </u>	= \$ <u> </u>
2. Logging Rock Core *	\$ <u> </u>	x <u> </u>	x <u> </u>	= \$ <u> </u>
3. Soil Classifications	\$ <u> </u>	x <u> </u>	x <u> </u>	= \$ <u> </u>
4. Wash and Sieve Gradations	\$ <u> </u>	x <u> </u>	x <u> </u>	= \$ <u> </u>
5. Moisture/Density/CBR/Soil Classifications	\$ <u> </u>	x <u> </u>	x <u> </u>	= \$ <u> </u>
6. Moisture/Density Test	\$ <u> </u>	x <u> </u>	x <u> </u>	= \$ <u> </u>
7. Slake Durability Index & Jar Slake Tests	\$ <u> </u>	x <u> </u>	x <u> </u>	= \$ <u> </u>
8. Unconfined Compression Tests on Soil	\$ <u> </u>	x <u> </u>	x <u> </u>	= \$ <u> </u>
9. Unconfined Compression Tests on Rock	\$ <u> </u>	x <u> </u>	x <u> </u>	= \$ <u> </u>
10. One-Dimensional Consolidation Tests	\$ <u> </u>	x <u> </u>	x <u> </u>	= \$ <u> </u>
11. Consolidated-Undrained Triaxial Tests with Pore Pressure Measurements	\$ <u> </u>	x <u> </u>	x <u> </u>	= \$ <u> </u>
12. Unconsolidated-Undrained Triaxial Tests, Total Stress Method	\$ <u> </u>	x <u> </u>	x <u> </u>	= \$ <u> </u>
13. Slope Stability Analyses	\$ <u> </u>	x <u> </u>	<u> </u>	= \$ <u> </u>
	\$ <u> </u>	x <u> </u>	<u> </u>	= \$ <u> </u>
14. Settlement Analyses	\$ <u> </u>	x <u> </u>	<u> </u>	= \$ <u> </u>
	\$ <u> </u>	x <u> </u>	<u> </u>	= \$ <u> </u>
15. Deep Foundation Analyses	\$ <u> </u>	x <u> </u>	<u> </u>	= \$ <u> </u>
	\$ <u> </u>	x <u> </u>	<u> </u>	= \$ <u> </u>
16. Wave Equation Driveability Analyses	\$ <u> </u>	x <u> </u>	<u> </u>	= \$ <u> </u>
	\$ <u> </u>	x <u> </u>	<u> </u>	= \$ <u> </u>
17. Negative Skin Friction Analyses	\$ <u> </u>	x <u> </u>	<u> </u>	= \$ <u> </u>
	\$ <u> </u>	x <u> </u>	<u> </u>	= \$ <u> </u>
18. Bearing Capacity Analyses	\$ <u> </u>	x <u> </u>	<u> </u>	= \$ <u> </u>
	\$ <u> </u>	x <u> </u>	<u> </u>	= \$ <u> </u>
19. Retaining Wall Analyses	\$ <u> </u>	x <u> </u>	<u> </u>	= \$ <u> </u>
	\$ <u> </u>	x <u> </u>	<u> </u>	= \$ <u> </u>

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KENTUCKY TRANSPORTATION CABINET
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Geotechnical Branch

SUMMARY OF COST ITEMS FOR STATEWIDE GEOTECHNICAL ENGINEERING SERVICES

COUNTY _____	ITEM No. _____				
20. Drafting	\$ _____	x	_____	=	\$ _____
	\$ _____	x	_____	=	\$ _____
21. Preliminary Plans *	\$ _____	x	_____	=	\$ _____
22. Preliminary Meetings *	\$ _____	x	_____	=	\$ _____
23. Rock Core Meetings *	\$ _____	x	_____	=	\$ _____
24. Interim Meetings *	\$ _____	x	_____	=	\$ _____
25. Final Meetings *	\$ _____	x	_____	=	\$ _____
26. Report Writing *	\$ _____	x	_____	=	\$ _____
27. Publication of Reports *	\$ _____	x	_____	=	\$ _____
			Subtotal	=	\$ _____
			Plus 10 percent	=	\$ _____
28. Direct Cost					\$ _____
TOTAL THIS ESTIMATE					\$ _____
ACCUMULATED TOTAL ESTIMATES	_____	THROUGH	_____	=	\$ _____
* Please provide additional justification for these items.			FIRM NAME	_____	
			SIGNED	_____	
			DATE	_____	

